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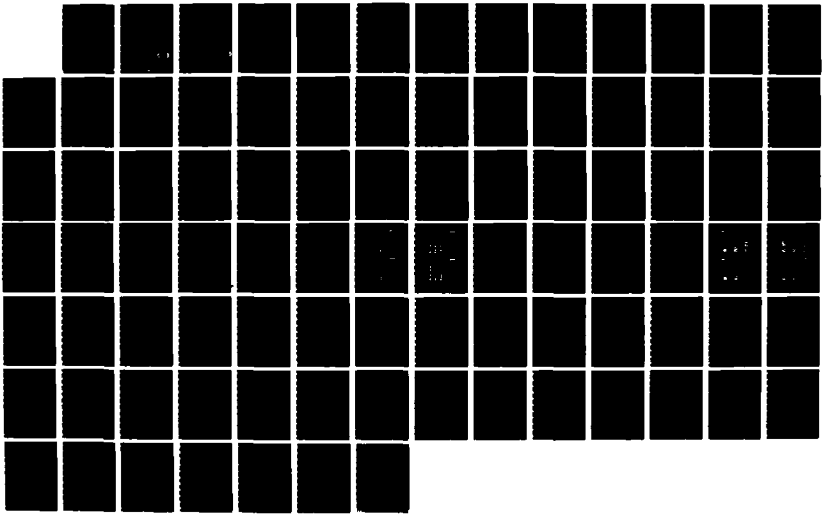

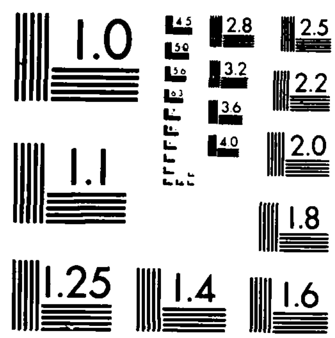

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AD-A174 456

AN EVALUATION OF A MULTIYEAR
SIMULATION MODEL

THESIS

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Captain, USAF

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DEPARTMENT OF THE AIR FORCE
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THESIS

Presented to the Faculty of the School of Systems and Logistics

of the Air Force Institute of Technology

Air University

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Sylvia C. Wardley-Niemi, B.A.

Captain, USAF

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Table of Contents

List of Figures

List of Tables

Abstract

In recent years the Department of Defense has received a great deal of publicity concerning the acquisition of spare parts. The management of spare parts is big business. The spare parts portion of the Department of Defense (DOD) budget for FY86 was 22.4 billion. With this, DOD has procured about 700,000 spare parts.

The purpose of this ~~research effort~~ was to validate the MYP simulation model that was developed in 1985. Two separate approaches were used to validate the model. The first approach was to identify the key cost drivers associated with making a MYP decision. The second approach involved acquiring data on 18 F-16 spare parts that were similar to the 8 B-1B spare parts used to develop the model. A literature review and numerous interviews were performed in order to achieve the purpose of the thesis. This research confirmed that the two major cost drivers for a MYP decision are: 1) acquisition savings due to buying material in larger quantities, and 2) the potential ECP costs. F-16 data was ran through the model to see how the model would work with another major weapon system that has different cost data, reliability and maintainability, quantities and mission profile. The data was ran through the model and the results supported the MYP decisions made at Air Logistics Center at Hill AFB, Utah. The purpose of this model is to aid the decision maker in making appropriate and timely MYP decisions.

AN EVALUATION OF A MULTIYEAR

SIMULATION MODEL

I. Introduction

General Issue

The management of spare parts in the Department of Defense (DOD) is big business. The DOD has approximately 4 million spare parts in inventory and procures about 700,000 spare parts each year (27:1). This results in DOD making 15 million procurement transactions yearly, which must be processed through some 1,000 buying offices. The government thus does business with about 300,000 contractors yearly (27:1).

The Air Force procures spare parts by initial provisioning and follow-on procurements (38). Spare parts for new Air Force systems are acquired by a three-phased process: 1) An optimum repair level analysis (ORLA) is performed on major line replacement units (LRUs) or systems to determine the most efficient maintenance concept to support the component. 2) After the maintenance concept is determined the provisioning office assigns a source maintainability recoverability code (SMR). This code identifies which items are logical spares. 3) Finally, a recommended quantity for the logical spares is computed and procurement action is initiated (1:6).

The computed quantity represents an estimate for the initial two years operational requirements. Next, the item is cataloged and assigned to an item manager (IM), which assures a single point of

control (1:16). Air Force Logistic Command Regulation 65-1 provides guidance regarding provisioning fundamentals (4:4).

Spare parts for follow-on, replenishment support uses the DO 41 (Recoverable Consumption Items Requirements Systems) for stock control management of recoverable spares (1:6). After the second year of operation the IM for recoverable items uses the computation system from the DO 41 to monitor the current reliability of the spares and identifies how many new spares must be procured and when they are required (1:8). The DO 41 review is performed on a quarterly basis. If the review shows a shortage of spares exists, the IM issues a new purchase request (PR) to buy more spares. If the review shows an excess of spares, the IM can cancel existing PRs (24).

The spare parts portion of the DOD's budget is very costly and extremely complex. The increase in cost of spare parts from 1982 to 1986 is shown in Table 1.

TABLE 1

Spare Parts Cost Increase

Fiscal Year	Dollars in billions
1982	$15.5
1983	17.3
1984	21.2
1985	21.6
1986	22.4

(44:1)

The spares budget is used to buy consumable and repairable parts for the nation's weapons systems which consist of aircraft, ships, tanks, submarines, vehicles, artillery, and more (12:1). Failure to have spares on hand when and where they are needed can result in mission failure, lost opportunity, systems that are not operational, and poorly trained personnel (12:1). Because the cost is so high and need for spares is so important, the DOD is always looking for ways to improve the management and reduce the cost of spare parts. In December 1984 the Spares Program Management Office was created to coordinate and integrate the spare parts activities within the DOD (12:1). "The Spares Management Improvement Program (SMIP) was the vehicle designed to address the longstanding systematic problems that have historically plagued spares acquisition and management" (12:3). The purpose of SMIP is to reduce the cost of spare parts and eliminate the barriers to the efficient and cost effective acquisition and management of spare parts (12:1). The first full year of operation for the SMIP was 1985, and during that year the DOD documented net cost savings/avoidance of $1.3 billion (12:3). Some of the improvements in the acquisition and management of spare parts are as follows:

1. Over 211,000 items in FY 1984 for breakout to enhance competition.
2. Debarred or suspended over 150 contractors who did not meet their legal obligations.
3. Increased the use of multi-year contracts and the integration of spare parts orders with production contracts. (12:2-3)

Several methods have been identified by the Air Force to reduce the cost of procurring spare parts. One method is called

spare parts breakout program and is detailed in Air Force Logistic Command Regulation 57-6 titled DOD High Dollar Spares Breakout Program (36; 38). This program encourages the breakout of spare parts acquisition from the prime contractor to approved subcontractors. Breakout procurement is a means by which the DOD purchases end items directly from a manufacturer or subcontractor and then furnishes the item to the prime contractor as government furnished equipment. This process allows the government to save the indirect cost and profits charged by the prime contractor to procure the item (38).

Another method to reduce the acquisition cost of spares is called spares acquisition integrated with production (SAIP), Air Force Regulation 800-26 titled "Spares Acquisition Integrated with Production" provides guidance for this program. SAIP is a means of awarding the contractor the initial spares order in conjunction with the production orders. This method reduces the unit cost because of larger buys and fewer administrative cost (38). Since 1985 the DOD has made it mandatory for acquisition managers to consider the use of SAIP with the production of end items. In fiscal year (FY) 1985 DOD estimated a savings of $45 million. The Air Force has applied SAIP to the F-16, F-15 and A-10 programs (38). However, there are problems with SAIP (1). Neither the contractor nor the government is ready prior to production to establish firm requirements in a timely manner. In order to establish the requirements the contractor must have time to project failure rates, develop a maintenance concept and estimate the quantity of items needed. Additionally, the government has "an equally hard task of justifying and obtaining necessary funding to support the

requirements" (4:5). These problems have resulted in limited use of SAIP.

Multiyear Procurement (MYP) is another way of significantly reducing the acquisition cost of spare parts. MYP became a major issue when the Reagan Administration advocated its use for major weapons systems as a "means of achieving defense objectives at reasonable cost (6). This method extends contractual coverage on a program from two to five years. Cost reductions are possible with MYP because the government is able to purchase large quantities of items at today's prices for delivery some day in the future. However, MYP involves risks such as overbuys/underbuys, obsolescence and program cancellation (29:15). Table 2 displays the MYP candidates included in the DOD 1985

TABLE 2

FY85 Multiyear Candidates Savings Estimates

		Estimated Contract Cost*			
System		Annual	Multiyear	Savings	%**
Air Force	F-16 Airframe	$ 4,253.5	$ 3,895.2	$ 358.3	8.4
	Bradley Turret Drive	130.1	114.0	16.1	12.4
	DSCS III	888.9	713.1	175.8	19.8
Army	UH/EH-60 Airframe	1,376.3	1,250.0	126.3	9.2
	CH-47D Modernization	1,434.8	1,281.4	153.4	10.7
	5-Ton Missile	1,001.6	936.1	65.5	6.5
	TOW II Missile	1,175.9	1,058.2	117.7	10.0
	Shop Equipment CMV	215.4	141.1	74.3	34.5
	Bradley 25mm Gun	238.5	227.7	10.8	4.5
	Bushmaster 25mm Gun	156.8	114.8	12.0	7.7
Navy	CH/MH-53E Airframe	886.7	759.3	127.4	14.4
	AN/SSQ-36 Sonobuoy	13.2	11.6	1.6	12.1
	TOTAL	$11,771.7	$10,532.5	$ 1,239.1	10.5

(43:11)

* Dollars in millions
** Percent of savings compared to annual contract cost

budget, along with the estimated savings of MYP over annual contracts. Table 3 displays the sources of the estimated savings.

TABLE 3

Total Savings by Source

Source of Savings	Percent of Total Savings
Inflation	30.6
Vendor Procurement	47.9
Manufacturing	17.0
Other	4.5

(43:12)

Specific Problem

A multiyear procurement simulation model was developed in 1985 to evaluate the economics of making a MYP decision on spare parts acquisitions. The data used in the development and application of the model was based on the B-1B program. The findings from the study showed that the two major cost drivers in a MYP decision are the expected MYP up-front savings compared to the risk of engineering change proposal (ECP) costs under a MYP option. The model was developed and tested using B-1B acquisition data and to date has not been validated with any other major weapon system acquisition data.

Scope and Limitations

This research concentrates on the validity of the MYP simulation model. The research evaluates whether all significant cost drivers were identified in the model and adds discounting and internal rate of return (IRR) procedures to the model. The original model was developed

and applied by using data of eight B-1B spare parts. This research involved the use of data from fourteen F-16C/D and four F-16 common replenishment spare parts o validate the model. The purpose of validating the model was to see how the model would work on another major weapon system with different cost data, reliability and maintainability requirements, quantities and mission profile. These items met the same guidelines as those selected in the base model, which included simple, moderate, and complex parts of high and low value (4:8). Thirteen of the items were selected from the 278 MYP candidates proposed by General Dynamics (36), while the other five items are from the F-16 spares survey (1).

The primary limitation to the study was a lack of historical information concerning both the MYP and the annual proposed prices of MYP candidates. The list from General Dynamics was screened and narrowed down by the government to 51 items. The primary reason was due to change in requirements. The list was further limited to 13 items, and only the average unit MYP and annual price (as proposed in FY85) were available on these items (36). As of 26 June 1986 only six of these items had been definitized as multiyear contracts and of those six, only two are still on multiyear contract. The other four were cancelled after the first year because of changes in requirements (25; 27; 49). The two items from the General Dynamics list that are still on multiyear contract are the ISA rudder and the ISA flap.

In order to expand the number of items, the researcher included the items identified in the F-16 Spares Survey involving the SPO, General Dynamics, and the Air Logistics Center at Hill Air Force Base,

Ogden, Utah (OO-ALC). The survey evaluated five critical parts as MYP candidates (1:4): ISA horizontal tail, rotary actuator, GN2 valve, AOA transmitter, and command servo. Four of the five items are F-16 common, while the fifth item is peculiar to the F-16C/D.

This dearth of information led to scoping down the thesis. The total number of F-16 items to be evaluated is 18. These were the only items that both the estimated MYP and estimated annual prices were available. A list of the 18 F-16 spare parts, along with their item characteristics, is provided in Table 4.

Hypothesis

This research investigates the hypothesis that the MYP simulation model is a valid method for determining MYP candidates. This research attempts to validate the MYP simulation model and expand the research.

Research Questions

1. Are all the significant cost drivers associated with a MYP decision accounted for in the MYP simulation model?
2. Does the projected number of ECPs have an impact on the MYP decision?
3. Does discounting have an impact on MYP decisions?
4. How sensitive are the discount rates?
5. Does the program scenario change the results of the model?
6. If a discount rate of 10 percent were applied to the B-1B items, would the MYP decision change?

TABLE 4

Item Charateristics

Item Name/National Stock No.	QPA*	Est. Annual Price	Est. MYP Price	Current MTBD** (hours)	*** NRTS
ISA Flap 1680-01-165-7203WF	4	40976	33749	1014	100%
ISA Rudder 1680-01-106-1594WF	1	43289	33745	1071	100%
Heads Up Display Unit 1270-NC-E319567WF	1	72642	66038	154	0%
Electronic Unit 1270-01-165-0276WF	1	75336	68487	154	100%
Power Supply Display 5841-01-143-5943WF	1C/2D	8358	7598	740	100%
Data Entry Display 5895-01-143-5443WF	1C/2D	25644	23313	384	100%
Enhanced Fire Control Computer 1270-01-141-7376WF	1	113265	110461	438	98%
Accessory Drive Gear Box 2835-01-140-1623WF	1	87613	75307	4878	79%
Drive Assembly 1650-01-145-0046WF	1	47097	43898	411	90%
Angle of Attack Transmitter 6610-01-222-6439WF	2	2037	2096	1172	100%
GN2 Valve Pack 4810-01-099-6392WF	1	3103	2824	1866	98%
Rotary Actuator 1680-01-148-8977WF	2	4616	4585	1172	100%
Command Servo-C 1680-01-165-7203WF	1	3374	3361	3534	100%
ISA Horizontal Tail 1680-01-150-8939WF	4	27103	26202	1014	100%
Programmable Memory Control 1650-01-165-1965WF	2	15633	14122	1205	100%
Power Supply 6130-01-140-2238WF	2	6165	4102	10000	100%
Multi-Function Display 1260-01-143-5440WF	2C/4D	20355	19117	696	100%
Programmable Display Generator 1260-01-143-5439WF	1	58885	54760	116	0%

* QPA = Quantity per aircraft
** MTBD = Mean time between demand
*** NRTS = Not repair this station

II. Background

Multiyear Procurement

"Multiyear procurements (MYPs), under certain circumstances, offer several important advantages to the Air Force and to the nation" (7:1). MYP can reduce acquisition cost, promote capital investment, increase production efficiency and provide workforce stability (39:28). MYP is a means by which the DOD plans requirements for a two- to five-year period with a single contract without having total funds available at the time the contract is awarded (11:17-1). As such, MYP is an exception to DOD Directive 7200.4, which requires that all funds needed to cover the total cost of production (with the exception of some long lead-time components) be available at the time the contract is awarded (39:28; 7:1). MYP is an alternative to a series of annual contracts in which the items are procured one year at a time (39:28).

MYP is not a new idea. It has been used primarily for the acquisition of goods and services and, under special circumstances, for the procurement of major weapon systems. However, in recent years MYP has been used in the procurement of spare parts and support equipment. Public Law 97-86 gave congressional authority to the DOD to pursue MYP as a viable method to reduce acquisition cost through the use of economic-lot purchases and efficient production rates (43:14).

The two major sources of cost savings resulting from MYP acquisition are "1) the ability to purchase parts and material in 'economic order quantities' (EOQ); and 2) inflation avoidance through

advance procurement of parts and materials for future delivery at current prices" (7:2; 30; 31).

The Air Staff has divided MYP into three categories: small, intermediate and major:

1. Small MYP. A small MYP is one that has a total procurement of $1 billion or less; research, development, test and evaluation (RDT&E) of $200 million or less, including an EOQ advance buy of $20 million or less or an unfunded cancellation ceiling of $20 million or less.

2. Intermediate MYP. An intermediate MYP has the same procurement and RDT&E restrictions, but the EOQ advance buy or unfunded cancellation ceiling is above $20 million.

3. Major MYP. A major MYP involves a total procurement in excess of $1 billion. (46)

The approval cycle for each of the three categories of MYP are listed in Table 5. Under the three categories there are two types of MYP, classic and expanded (19:36-1). The classic MYP allows only nonrecurring cost to be included in the contract cancellation ceiling (19:36-1), while the expanded MYP provides "advance authorization and/or funding for specific contractor recurring costs" (19:36-1).

MYP History

MYP was first used in the DOD in the early 1960s by the Department of the Army to produce material used on a recurring basis for its base facilities (33:43). The Navy began to use MYP for major systems in the late sixties through the early seventies (33:43). During the seventies the use of MYP dramatically declined. The decline was the result of significant cost overruns of two multiyear ship-building programs.

In response, Congress established a $5 million cancellation ceiling in the Armed Forces Authorization Act of 1973 (15:20; 29:15-16).

TABLE 5

Approval and Congressional Notification Requirements by Multiyear Category

Approval Level For:	Small (1)	Intermediate (2)	Large (3)
Initial Findings:	HCA	AF/RDC	SAF/AL
Validation Findings:			
$S_V \geq S_I$	MAA	MAA	MAA
$S_V < S_I$	HCA	AF/RDC	SAF/AL
$P_V < 0$	HCA	AF/RDC	SAF/AL
$MY_{Neg} \leq MY_{Prop}$	CO	CO	CO
$MY_{Neg} > MY_{Prop}$	MAA	MAA	MAA

Abbreviations:

- CO - Contracting Officer
- HCA - Head of Contracting Activity (or delegate)
- MAA - DOD Budget Guidance Manual Approval Authority
- MY_{Prop} - Multiyear price as initially proposed
- MY_{Neg} - Multiyear price as finally negotiated
- P_V - Present value of cost savings
- S_V - Validated MYP savings
- S_I - Initial MYP savings estimate

(7:41)

Note: Initial Findings includes program office estimates of costs for both annual year and MYP options. This approval provides authority to the government to solicit proposals on both multiyear and annual year contract basis. Once the Initial Findings are approved the cost data for both options are analyzed by the contracting officer to ensure their validity. Should-cost and fact-finding exercises are performed as needed and then a set of Validation findings are prepared prior to the initiation of the multiyear contract effort. (7:44)

A cancellation ceiling is the maximum amount that the government is liable for in the event a contract is cancelled (23:54). This resulted in an unwillingness by contractors to accept a multiyear contract. However, as the 1980s approached the method of procurring weapon systems on an annual basis became too expensive and lengthy for the DOD. As a result, in 1981 the DOD Acquisition Improvement Program was established.

In April 1981, Deputy Secretary of Defense, Frank C. Carlucci, issued a memorandum entitled "Improving the Acquisition Process." The memo contained 32 initiatives designed to shorten the acquisition process, increase readiness, provide cost savings, and strengthen the industrial base (6). The third initiative of this memo was to enhance the currently used version of MYP for acquiring weapons systems parts, equipment and non-major defense systems (6).

In FY82 Congress raised the cancellation ceiling to $100 million per contract (15:20). This became a part of the DOD Authorization Act of 1982. Section 909 of the Act stated that:

> 1) advanced procurement could be used to get economic lot pieces; 2) the cancellation ceiling could include non-recurring, as well as recurring costs; and 3) Congress is to be notified of cancellation ceiling above $100 million. (9:19)

In January 1982 the Air Force awarded a four-year contract to General Dynamics for 480 F-16 Fighter aircraft (3:1). The Air Force estimated a savings of $325.8 million by using a MYP versus using four annual contracts (41:9).

The primary reason for MYP is to provide the government a way of realizing cost saving while stimulating the defense industrial base. However, there are both advantages and disadvantages in using MYP.

MYP Advantages. The use of MYP has the potential for tremendous benefits for both the government and the defense contractor. The potential of MYP benefits have been identified in the Federal Acquisition Regulation (FAR) and in testimony before Congress (11:17-2; 39). These benefits are:

1. Lower costs.

2. Enhancement of standardization

3. Reduction of administrative burden in the placement and administration of contracts.

4. Substantial continuity of production or performance, thus avoiding annual startup costs, preproduction testing costs, makeready expenses, and phaseout costs.

5. Stabilization of contractor work forces.

6. Avoidance of the need for establishing and "proving out" quality control techniques and procedures for a new contractor each year.

7. Broadening the competitive base with opportunity for participation by firms not otherwise willing or able to compete for lesser quantities, particularly in cases involving high startup costs.

8. Provide incentives to contractors to improve productivity through investment in capital facilities, equipment, and advanced technology. (17:2; 11:17-2)

The lower costs are attributed to economies of scale, higher learning rates, economic quantity buys and more efficient production rates (39:28-33). The FAR requires that a program/project be stable in order for MYP to be implemented; therefore, the use of MYP results

in increased productivity and stable work force. Contractors are encouraged to modernize their plants because they can amortize investment cost over a two- to five-year period instead of a single year. "Since MYP encourages advanced material buys and modernized plants, the U.S. defense industry can better respond to national emergencies" (3:4).

MYP is not a panacea for all acquisition problems. The use of MYP must be determined on a case-by-case basis to make sure the benefits outweigh the cost.

MYP Disadvantages. A major disadvantage of MYP is the reduced flexibility Congress has in controlling the budget. Because MYP is a long-term commitment, it reduces the controllable portion of the spare parts budget. The controllable portion of the budget is that amount not obligated by contract.

The risk of contract cancellation is a disadvantage the contractor must consider. In order to offer some protection to the contractor a cancellation ceiling is entered in the contract. A contract is only canceled by the Government if the program is no longer in the nation's best interest. This could be due to contractor performance or a change in the threat (3:5). Another disadvantage is that MYP entails large amounts of capital up front in order to purchase material in advance and to modernize their plant, which could result in a significant cash flow problem (26). There is also concern that after being awarded a long-term contract, the opportunity to compete for follow-on buys may dwindle because of the high cost of tooling (35).

MYP Criteria. The criteria for MYP of spare parts are identical to those of major weapon system acquisitions. MYP is appropriate when the following criteria are satisfied:

1. Benefit to the Government. A multi-year procurement should yield substantial cost avoidance or other benefits when compared to annual contracting methods. MYP structures with greater risk to the Government should demonstrate increased cost avoidance or other benefits over those with lower risk.

2. Stability of Requirement. The minimum need for the production item or service is expected to remain unchanged or vary only slightly during the contemplated contract period in terms of production rate, fiscal year phasing, and total quantities.

3. Stability of Funding. There should be a reasonable expectation that the program is likely to be funded at the required level throughout the contract period.

4. Stable Configuration. The item should be technically mature, have completed RDT&E (test and evaluation) with relatively few changes in item design anticipated and underlying technology should be stable.

5. Degree of Cost Confidence. There should be a reasonable assurance that cost estimates for both contract costs and anticipated cost avoidance are realistic. Estimates should be based on prior cost history for the same or similar items or proven cost estimating techniques.

6. Degree of Confidence in Contractor Capability. There should be confidence that the potential contractor can perform adequately, both in terms of Government furnished items and the firm's capabilities. (6:Enc 2)

F-16 Multiyear Production Contract

The F-16 is a multimission fighter, single engine, light-weight aircraft that is manufactured by General Dynamics for the Air Force and certain foreign countries. The aircraft is designed for air-to-air combat and delivery of air-to-surface weapons. In October 1981, the Air Force formally proposed buying F-16s with a multiyear contract.

By that time General Dynamics had delivered over 500 F-16s to the Air Force and foreign customers (41:8).

Therefore, in December 1981, DOD approved the use of MYP to procure 480 F-16s over a four-year period (FY82-FY85) at a rate of 120 F-16s per year (41:8). The contract included the F-16 airframe and certain related equipment (41:8). One-third of the total F-16 cost was for the airframe.

General Dynamics submitted both an annual and a multiyear proposal for the same quantity of aircraft. The annual estimate was made up of four separate contracts of 120 aircraft, while the multiyear estimate was a single contract for 480 aircraft. The following is a comparison of the two contracts as originally proposed by General Dynamics (41:9):

		Dollars in Millions		
	Annual	Multiyear	Savings	% Savings
F-16 Airframe	$2,897.6	$ 2,571.8	325.8	11.2

The largest portion of savings was from economic order quantity or expanded buy of subsystems. The estimated savings from the subsystem procurement is approximately $149 million in then-year dollars (41:11). Table 6 provides a break-out of the estimated total subsystems savings (41:12).

General Dynamics cited several benefits that were realized from the use of the F-16 multiyear contract:

> 1) More incentive to invest capital in new technology and modern equipment because of the long-term nature of a multiyear contract and industry desire to reduce manufacturing costs; 2) protection against materials and parts lead-time increases; 3) more competitive in international sales; and 4) additional surge production output potential. (41:15)

TABLE 6

Estimated Subsystem Savings

Category	Savings*
Subsystems Procurement	$ 87,299,218**
Procurement Overhead	18,863,699
Product Liability	165,521
General and Administrative Expenses	18,901,050
Cost of Money	856,838
TOTAL COST SAVINGS	126,086,326
Profit Savings	17,652,095
TOTAL PRICE SAVINGS	143,738,421
Estimated Savings for Planned Airframe Improvements	5,200,000
TOTAL SUBSYSTEMS SAVINGS	$148,938,421

(41:12)

* Estimated amount of total subsystem savings between multiyear and annual contracts in current dollars

** Air Force's estimate shows this is equivalent to $29.8 million when expressed in constant January 1980 dollars

In addition to the cost savings, F-16 officials cited "enhanced investment, less training, and lower administrative costs" (41:16) as benefits from using MYP.

The Air Force and General Dynamics negotiated a follow-on multiyear contract in FY85. This contract will be for four years, with delivery beginning in June 1987 and continuing through May 1991. The contract will be for 720 F-16s at a rate of 180 per year with a variation in quantity clause, providing negotiated prices for up to 36 additional aircraft each year.

Current Status of MYP

The Department of Defense has pointed to MYP as a way to significantly reduce the cost of procuring weapon systems. The 1982 Defense Authorization Act increased DOD authority to pursue MYP. In the FY86 budget, DOD submitted 10 candidates for approval of multiyear procurement authority. DOD estimated the total savings to be $1,608.8 million in then-year dollars, or about 12.9 percent less than the cost of procurement on an annual basis (42:10). A list of FY86 multiyear candidates and their estimated savings over annual year procurement is shown in Table 7.

TABLE 7

FY86 Multiyear Candidates Savings Estimates

			Estimated Contract Cost*		
System		Annual	Multiyear	Savings	%**
Army	T700 Engine	$ 974.6	$ 871.2	$ 103.4	10.6
	M1A1 Tank Chassis	4,125.2	3,734.7	390.5	9.5
	M1A1 Tank Engine	1,283.0	1,122.2	160.8	12.5
	M1A1 Tank Fire Control	667.2	570.4	96.8	14.5
	M1A1 Tank Computer	54.9	44.4	10.5	19.1
	Bradley Fighting Vehicle Transmission	285.7	260.2	25.5	8.9
	M9 Armored Combat Earthmover	444.1	412.9	31.2	7.0
Navy	P-3C Airframe	756.0	690.5	65.5	8.7
	MK-46 Torpedo and Kits	554.5	503.1	51.4	9.3
	LHD Ship	3,296.0	2,622.8	673.2	20.4
	TOTAL	$12,441.2	$10,832.4	$ 1,608.8	12.9

(42:11)

* Millions of then-year dollars
** Percent of savings compared to annual contract cost

Because the rates of government expenditures differ between the annual year and multiyear procurement methods, DOD requires that present value analysis be used for comparison (7:28). Present value takes into consideration the time value of money. There is much controversy over the appropriate interest rate to be used. The Office of Management and Budget (OMB) Circular A-94 prescribes the present value method and uses a flat 10 percent discount rate to constant dollars (7:29). However, the General Accounting Office (GAO) uses the "average yield on outstanding marketable Treasury obligations that have remaining maturities similar to the period involved in the analysis" (43:10). DOD's and GAO's present values saving estimates for the same MYP candidates are shown in the Table 8. Sources of estimated savings for these candidates are listed in Table 9.

TABLE 8

Comparison of DOD and GAO Present Value Savings for FY86 Multiyear Candidates

System		DOD Present Value Savings*		GAO Present Value Savings**	
		Amount	%	Amount	%
Army	T700 Engine	$ 61.6	10.1	$ 69.6	10.2
	M1A1 Tank Chassis	209.5	8.9	245.6	9.1
	M1A1 Tank Engine	84.5	11.5	99.7	11.8
	M1A1 Tank Fire Control	49.9	12.8	59.2	13.3
	M1A1 Tank Computer	3.5	11.0	5.4	13.7
	Bradley Fighting Vehicle Transmission	14.9	8.0	16.0	8.3
	M9 Armored Combat Earthmover	21.4	8.4	21.2	8.0
Navy	P-3C Airframe	19.1	4.0	27.7	5.5
	MK-46 Torpedo and Kits	28.5	7.1	31.9	7.9
	LHD Ship	79.8	4.8	199.1	10.4
	TOTAL	$572.7	8.1	$775.4	9.7

(42:12)

* Percent of savings compared to DOD's present value annual contract cost in millions of dollars

** Percent of savings compared to GAO's present value annual contract cost in millions of dollars

TABLE 9

Sources of Estimated Savings

Source of Savings	Percent of Total Savings
Vendor Procurement	53.9
Inflation	29.0
Manufacturing	6.9
Other	10.2

(42:13)

III. Methodology

Overview

The purpose of this thesis was to validate the multiyear procurement (MYP) simulation model. This chapter presents a brief discussion of how the model evaluation was accomplished. In addition, it provides background information and a detailed discussion of the model.

In order to validate the model the researcher had to first become familiar with the subject. Therefore, a literature review and numerous interviews were conducted in the areas of MYP, spares requirements and acquisition, and the use of simulation modeling in the Air Force to make a MYP decision. The researcher then had to become familiar with and proficient in the use of SIMSCRIPT II.5, the programming language used in the model. After these tasks were completed the original B1-B data used to develop the model was ran. The results of this data was used as a baseline for comparison of future runs.

This research used two separate approaches to validate the MYP simulation model. The first approach was to identify the key cost drivers associated with making a MYP decision and to ensure that these costs were included in the model. This was done through literature research and interviews. The second approach involved acquiring like data on F-16 spares that were similar to the B-1B spares used in the original MYP model. Although matching item for item between the two different systems was difficult, it was necessary for the items of the F-16 and the B-1B to meet the same criteria to

achieve like comparisons. They had to range from simple and moderate to complex and be of both low and high dollar value. The following paragraphs provide background information and a detailed description of the model.

Background on MYP Simulation Model

The MYP simulation model was developed in a thesis in 1985 by Albert F. Bodnar. The purpose of the model was to "evaluate the cost impacts that would result from making a MYP decision versus an annual year decision on an item" (4:30). Research shows that there is no simulation model being used to date to determine MYP candidates (30:31). This model was developed as an aid for decision-makers to choose the candidates that are best suited for MYP. The model was not developed with the intention of accounting for all costs, but to key in on the major cost drivers that would impact a MYP decision. The key cost elements that were identified and accounted for in the model are: 1) spares; 2) engineering changes; 3) transportation; 4) storage; and 5) administration (4:32).

In addition to the key cost elements the program scenario and item characteristics are needed in order to run the model. The sources of information are (4:33):

Scenario	Characteristics	Key Cost Elements
Delivery Schedule	Acquisition Cost	Spares
Flying Hours	Failure Rate	Engineering Changes
	Stability	Storage
		Transportation
		Administration

The interaction between these elements are very complex and both the scenario and item characteristics are subject to change, especially in a new weapon system.

Simulation modeling was chosen due to the complexity involved in making a MYP decision. A simulation model represents reality.

> This MYP model stimulates the logistics environment of a part, estimates the required spares needed to support that item over time, and then estimates the expected key costs that would result from a MYP versus an annual year acquisition decision. (4:34)

Description of MYP Simulation Model

The MYP simulation model is written in SIMSCRIPT II.5 programming language. SIMSCRIPT is a high order language which uses near-English terminology (21). The SIMSCRIPT II.5 programming manual was developed by the Consolidated Analysis Centers, Inc., and written by Kiviat, Villanueva and Markowitz (21). A flowchart developed by Bodnar (4:69-73) and modified by this researcher explains the logic of the model (Figure 1). The MYP simulation program is hosted on the AFLC CREATE computer system, located at Wright-Patterson Air Force Base. The SIMSCRIPT computer code is located in Appendix C.

The first step in the model is to initialize all data elements, arrays, subroutines and events. The events control the passage of time. Once initialization is completed the data is read and the program events are scheduled. Event deployment (Step 2) allocates the aircraft to the bases. Event inspection (Step 3) controls the program operation. Once the aircraft is deployed, the first sortie is scheduled and subsequent sorties are scheduled after each sortie is completed. Once a sortie is completed, the aircraft is inspected

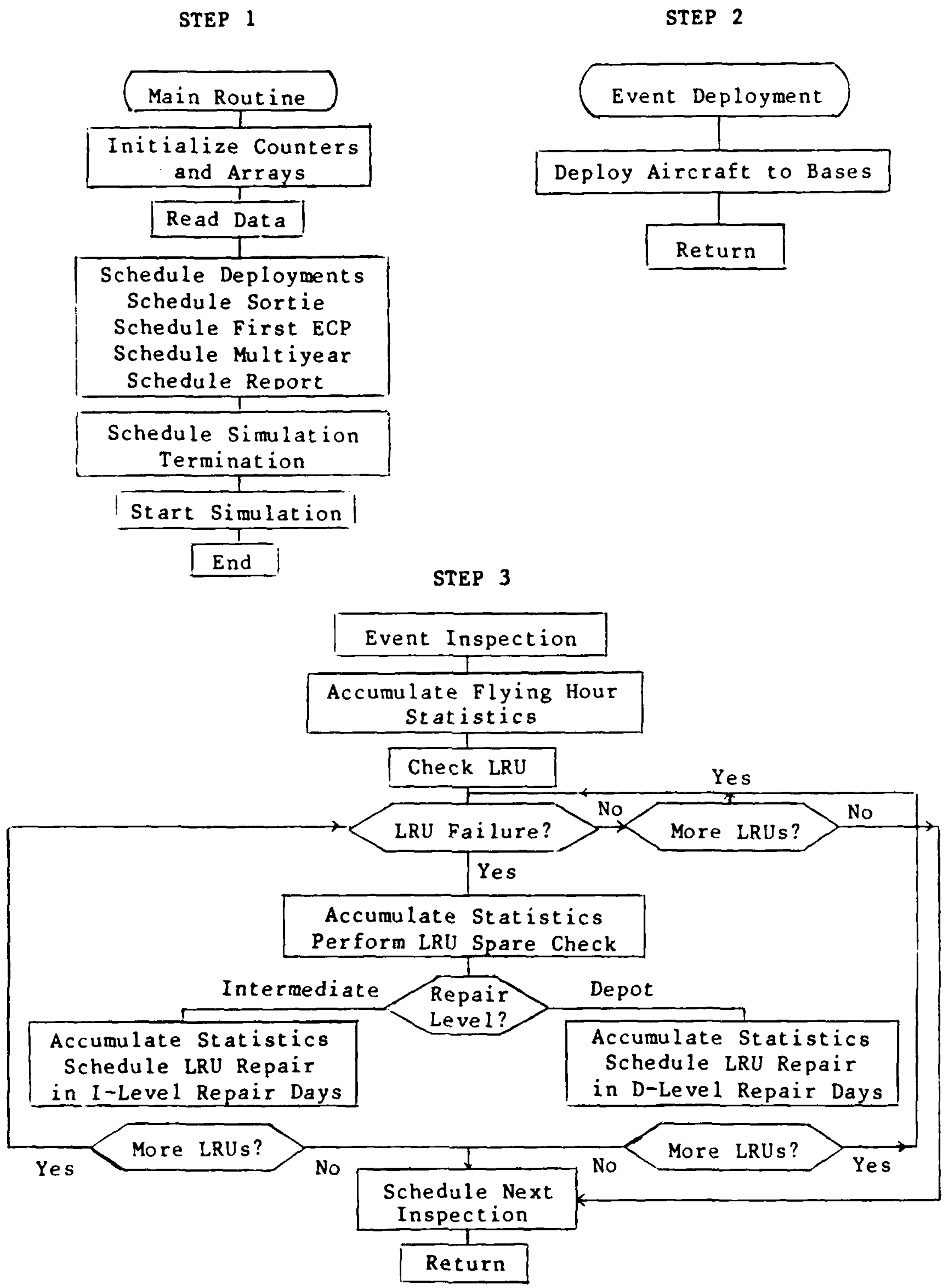
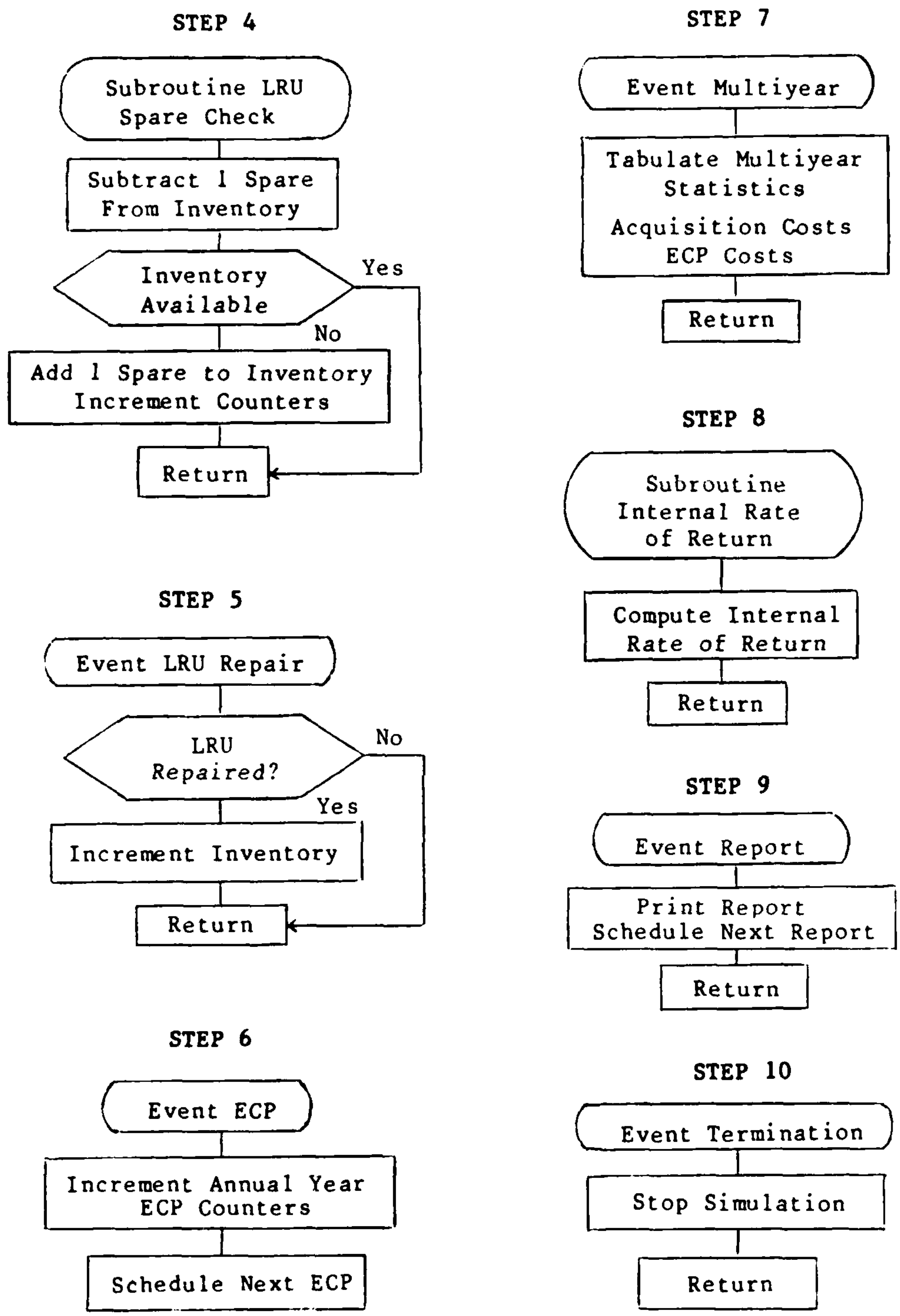


Figure 1. Program Flowchart



(4:69-73)

Figure 1 (continued)

for any failures. Each item being evaluated has a probability of failure which is calculated based on its failure rate and sortie length. The failure rate and sortie length, along with the other F-16 baseline data, is listed in the model input provided in Appendix B. Each item is individually inspected for failure. When an item fails, the model determines the location of repair, checks for an available spare, and schedules when the failed item will be available again. Then a check is made to determine if the repair was successful, since some items are not repairable and are thus condemned. The repair location and the condemnation rate are important because both have an impact on how many spares should be kept on hand. If the scheduled repair is to be performed at the depot, more time is needed to allow for getting the repaired part back to the aircraft. A high condemnation rate requires more spares to account for the item failing repair. The final phase of this step is to schedule the next inspection.

The "LRU check" subroutine (Step 4) determines the quantity of spares that will be required to support the system at any point in time. In addition, the spares cost is determined for the annual option in this subroutine. The spares cost for the annual year option is based on the annual price along with both the inflation and discount index (i.e., the current time in the simulation). Event LRU Repair checks for successful repair (Step 5). If the part cannot be repaired, another part is added to the total number of parts required. Engineering change activity is simulated by periodically injecting engineering change proposals (ECPs) into the model (Step 6). When an

ECP occurs the annual year ECP costs are tabulated by using the current quantity of spares and the cost of the ECP. Then the next ECP is scheduled according to the ECP projection rate. Event multiyear (Step 7) tabulates all the multiyear statistics and computes the spares cost under the MYP option. This cost is the total number of spares required multiplied by the MYP acquisition price. This event also calculates the ECP cost under the MYP option by taking the total quantity of spares acquired at the end of the simulation multiplied by the ECP cost. Explanation of how the other cost elements (administration, storage and transportation) are calculated both for the annual year and MYP options are explained below. The subroutine "internal rate of return" (Step 8) computes the IRR by taking the difference of the MYP price and the annual price and comparing the expected outyear savings to the increase in initial expenditures.

Administration cost is based on the cost involved in implementing the contract. For the annual option this is based on the number of years the items are procured. For a MYP option this is a one-time cost, since one contract would cover all required items (4:37). Storage cost is based on how many items are on hand times the cost of storing one part. This cost is lower for the annual option than for the MYP option (4:37). Transportation cost is the costs that are incurred when an ECP is scheduled. This expense is determined by the number of items, number of ECPs, and the shipping expense (4:37).

Event report (Step 9) prints a report showing end-of-year status which includes: 1) date simulation started; 2) inflations and discount factors; 3) delivery schedule; 4) base deployment schedule; 5) LRU

reliability and maintainability data; 6) flying hours; 7) operating hours; 8) number of sorties completed; 9) LRU removal data; 10) final cost breakdown; and 11) number of spare buildup by year. The last step (Step 10) is event termination, which stops the simulation.

The model was enhanced by adding discounting procedures and internal rate of return (IRR). Discounting, as explained in Chapter II, is a way of adjusting cash flows to take into account the present value of money and the opportunity cost of capital. The model has been expanded to take into account discount procedures applied to both constant and then-year dollars. Since the 10 percent prescribed by DOD is used in this model, sensitivity analysis was performed to see if the decision remains the same as the discount rate varies.

IRR was also added to the model. IRR is an alternative method of evaluating cost savings. IRR simply identifies the discount rate that will reduce the net present value and annual worth of a program to zero.

Chapter IV, Findings and Analysis, describes the data collection process, the findings, and the analysis of the results. Chapter V, Conclusions and Recommendations, presents the conclusions reached from this study and provides recommendations.

IV. Findings and Analysis

Overview

The purpose of this thesis was to validate the multiyear procurement (MYP) simulation model. This was accomplished by using the methodology outlined in Chapter III. This chapter describes the data collection, discusses the findings, and provides an analysis of the results.

Data Collection

A key step in validating the model was to collect the same type of data on the F-16 as was collected on the B-1B. To collect the data, a literature review was performed and numerous visits made to Air Logistics Center (OO-ALC) at Hill AFB UT, Headquarters Air Force Logistics Command (HQ AFLC) at Wright-Patterson AFB OH, and the F-16 Program Office at Wright-Patterson AFB. Additionally, many phone calls were made to General Dynamics and the Air Staff.

As with most research projects, some data was readily available while other data was extremely difficult to obtain. The reliability and maintainability data was available through the DO 41 system at HQ AFLC. The DO 41 Recoverable Consumption Item Requirements System provides a way to gather such data on replenishment spares as mean time between demand (MTBD) rate, the not repair this station (NRTS) rate, the condemnation rate, and quantity per aircraft (QPA). This data is available by national stock numbers (NSNs) and vendor's part numbers (PNs). Data on the number of spare parts procured by multiyear

contracts is an example of data that was difficult to obtain. Even more difficult to obtain were dual cost proposals (annual year and MYP prices) on all items. The projected number and cost of ECPs are also examples of data that was extremely difficult to collect. Yet, all this data on the 18 selected F-16 parts was necessary to validate the model. Both annual and MYP estimates were provided for the five parts identified in the F-16 Spares Survey. However, in order to get dual estimates on the other 13 parts, it was necessary for the researcher to go to the OO-ALC contracting office and review the contracts on these parts. Since none of the contracts were available at the local office, each part number had to be identified by the appropriate contract number to locate the corresponding contract file. Most of the contract files were in storage and had to be ordered and picked up the following day for review. This was a tedious and lengthy process. If the part had been procured through a multiyear contract, both annual and MYP estimates were available in the contract files. Only 6 of the 13 parts had been procured through multiyear contracts. However, estimates for all 13 parts were provided by the contracting office at OO-ALC.

Table 10 contains a list of the data required to validate and run this model, along with its sources. Table 11 displays the F-16 baseline data used in the evaluation. Although these are estimates and are subject to modification, they provide a framework to validate the model.

Findings and Analysis

The findings and analysis of the results are presented by answering the research questions proposed in Chapter I.

TABLE 10

Data Requirements

Elements	Data Needs	Source
Spares Cost	MYP Price	OO-ALC
	Annual Price	OO-ALC
	Operating Requirements	SPO
	Spares Requirements*	computed
	Requirement Profile	computed
	Maintenance Factor	AFLC
	Quantity per Application	AFLC
	NRTS Rate	AFLC
	Aircraft Delivery Schedule	SPO
	Inflation Factors	SPO
	Discount Factors	SPO
ECP Costs	Spares Requirements	computed
	ECP Costs	GD
	Number of ECPs	GD
Transportation	Spares Requirements	computed
	Number of ECPs	GD
	Shipping Costs	**
Storage	Spares Requirements	computed
	Storage Costs	**
Administration	Number of Buys	computed
	Administration Costs	**

* Spares Requirements = operating hours, delivery profile, item characteristics

** Same costs as used in the original model

TABLE 11

Baseline Data

Spare Parts	ECP Costs - 10% of Acquistion Price	Projected Number of ECPs Per Year Year 1	2	3	4	5
ISA Flap	4097	1	0	1	0	1
ISA Rudder	4329	3	4	4	4	2
Heads Up Display Unit	7264	1	0	1	0	1
Electronic Unit	7534	3	4	4	4	2
Power Supply Display	8358	2	1	1	1	1
Data Entry Display	2331	2	1	1	1	1
Enhanced Fire Control Computer	11327	2	2	2	2	2
Accessory Drive Gear Box	8761	1	0	1	0	1
Drive Assembly	4710	1	0	1	0	1
Angle of Attack Transmitter	2710	1	0	1	0	1
GN2 Valve Pack	310	1	0	1	0	1
Rotary Actuator	462	1	0	1	0	1
Command Servo-C	337	1	0	1	0	1
ISA Horizontal Tail	2710	1	0	1	0	1
Programmable Memory Control	1563	1	0	1	0	1
Power Supply	617	1	0	1	0	1
Multi-Function Display	2036	3	4	4	4	2
Programmable Display Generator	5889	3	4	4	4	2

ADMINISTRATION COSTS: $1000 per buy

SHIPPING COSTS:
LRU - $30 per event
SRU* - $10 per event

STORAGE COSTS:
LRU - $100 per year per unit
SRU* - $15 per year per unit

INFLATION RATE FACTORS: 5% per year after year 1

1st Year - 1.0
2nd Year - 1.05
3rd Year - 1.10
4th Year - 1.15
5th Year - 1.20

DISCOUNT RATE FACTORS: 10% per year after year 1

1st Year - 1.0
2nd Year - .909
3rd Year - .826
4th Year - .751
5th Year - .683

* Only LRUs are evaluated in this study

Research Question One. Are all significant cost drivers associated with a MYP decision accounted for in the MYP simulation model?

Bodnar initially identified five key cost elements and incorporated them into the model. These five cost elements are 1) spares; 2) engineering changes; 3) transportation; 4) storage; and 5) administration (4:32). However, results of Bodnar's study and this study confirm that there are only two significant cost drivers associated with a MYP decision: 1) acquisition savings due to buying material in larger quantities, and 2) the potential ECP costs.

As stated in Chapter II, before an item can be approved as a MYP candidate it must satisfy the following criteria:

1. Benefit to the Government. A multi-year procurement should yield substantial cost avoidance or other benefits when compared to annual contracting methods. MYP structures with greater risk to the Government should demonstrate increased cost avoidance or other benefits over those with lower risk.

2. Stability of Requirement. The minimum need for the production item or service is expected to remain unchanged or vary only slightly during the contemplated contract period in terms of production rate, fiscal year phasing, and total quantities.

3. Stability of Funding. There should be a reasonable expectation that the program is likely to be funded at the required level throughout the contract period.

4. Stable Configuration. The item should be technically mature, have completed RDT&E (test and evaluation) with relatively few changes in item design anticipated and underlying technology should be stable.

5. Degree of Cost Confidence. There should be a reasonable assurance that cost estimates for both contract costs and anticipated cost avoidance are realistic. Estimates should be based on prior cost history for the same or similar items or proven cost estimating techniques.

6. <u>Degree of Confidence in Contractor Capability</u>. There should be confidence that the potential contractor can perform adequately, both in terms of Government furnished items and the firm's capabilities. (6:Enc 2)

All the above criteria must be considered and quantified if at all possible. The two significant cost drivers identified support criteria numbers one and four.

A study prepared for the United States Air Force by Business Research Management Center through the Commonwealth Research Group, Inc., states that one of the major sources of savings resulting from MYP acquisition is "the ability to purchase parts and material in 'economic order quantities' (EOQ)" (7:2). Major Gary Poleskey, Contracting Staff Officer at the Air Staff, agrees that the largest amount of cost savings from MYP is due to the ability to purchase large quantities of material in advance (30).

Even though the cost of ECPs has a great impact on the total cost of a spare part if a part has a large number of ECPs projected, it would not be approved as a MYP candidate because criteria four states that the configuration of an item must be stable. However, if the cost of a projected ECP is high but no ECPs are projected, the item will be considered as a good MYP candidate if all the other criteria are met (30). Figure 2 illustrates the difference between the total cost and each of the cost elements for both the annual year and the MYP options as computed for the ISA flap. The figure shows that the spares acquisition cost under the MYP option is lower than the spares acquisition cost under the annual option. However, the total cost of the spares is higher under the MYP option because the ECP costs under

the MYP option is almost double the ECP costs under the annual year option. Figure 3 illustrates the same type of cost comparison for the ISA rudder. The total cost for the ISA rudder is slightly lower under the MYP option than under the annual year option. The lower total cost is a result of the upfront savings realized under the MYP option was high enough to offset the ECP costs. The same type of cost comparison was made on the heads up display unit and the electronic unit. These results are provided in Figures 4 and 5. These figures show that the acquisition cost of the spares for both items are slightly higher under the MYP option than they are under the annual year option. Likewise, the ECP costs for both items are higher under the MYP option. Therefore, the total cost for both items is lower under the annual year option. Table 12 shows the results from the MYP simulation model on all the items evaluated in this thesis. These calculations are the result of using the F-16 baseline data previously presented. As shown, the MYP decision is slightly favored on only two items, the ISA rudder and the power supply. The results of the cost comparison indicate the two major cost drivers are the acquisition cost of spares and the cost of ECP under the MYP option.

Research Question Two. Does the projected number of ECPs have an impact on the MYP decision?

The first step in answering research question two was to arrive at a projection of the number of ECPs for each of the 18 parts for the next five years. In order to come up with a realistic number, Mr. Tom Holland, Configuration Status Accountant at General Dynamics, Fort Worth, Texas, ran a history of each item to determine how many ECPs had

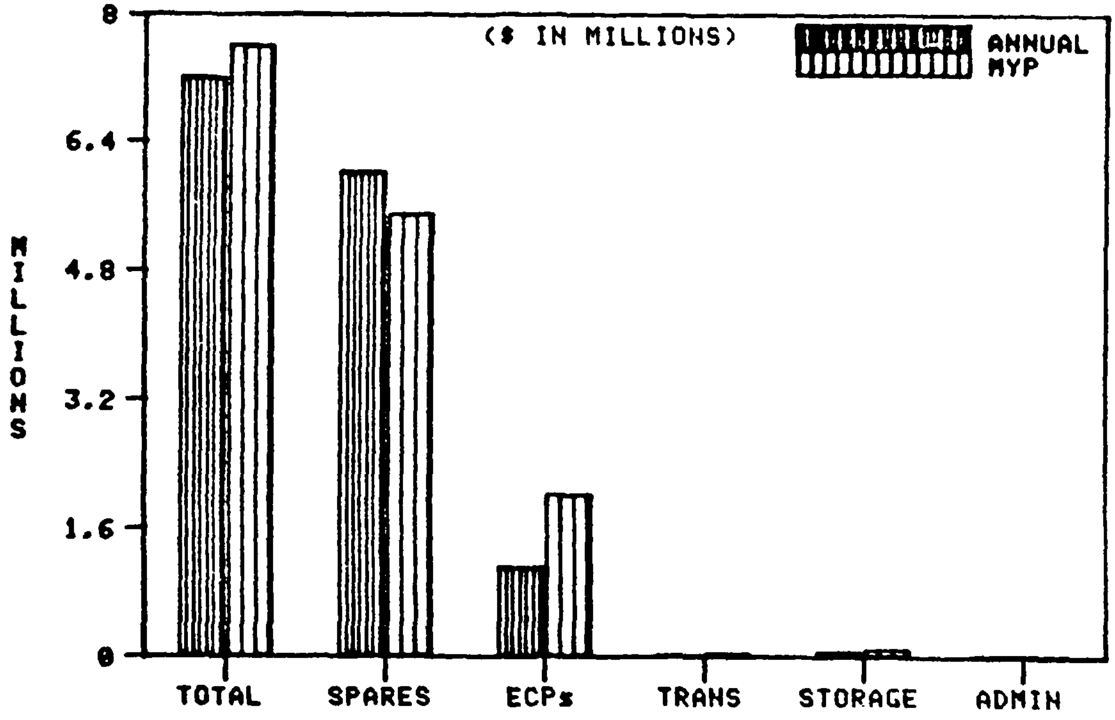


Figure 2. Cost Comparison for ISA Flap

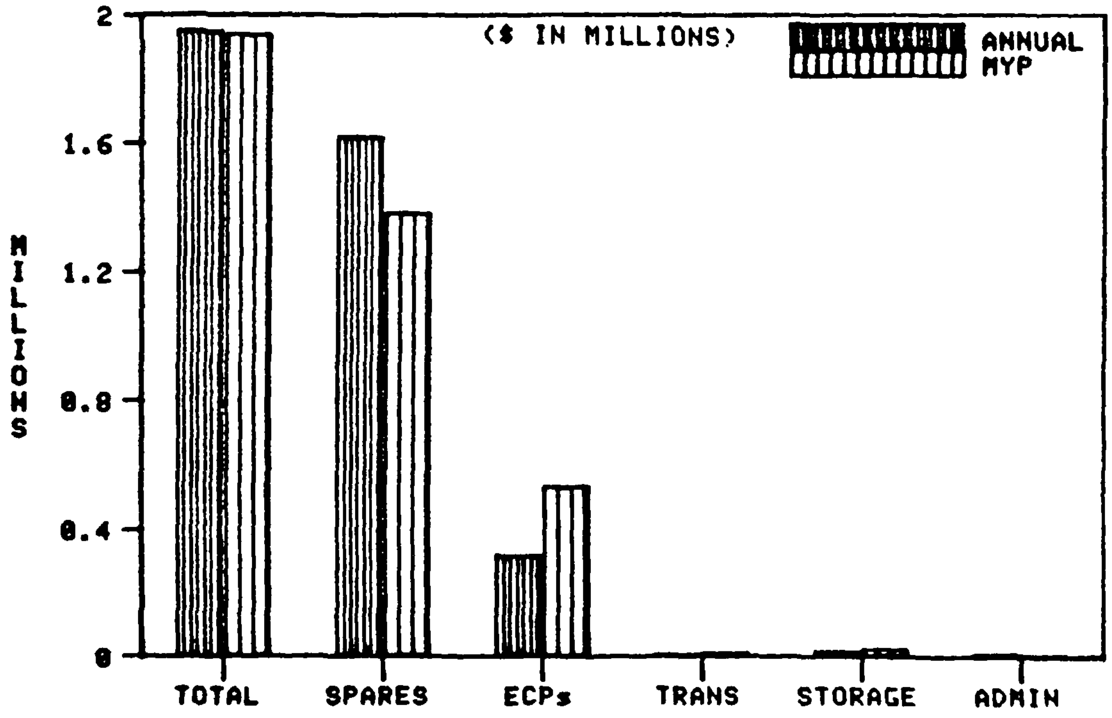


Figure 3. Cost Comparison for ISA Rudder

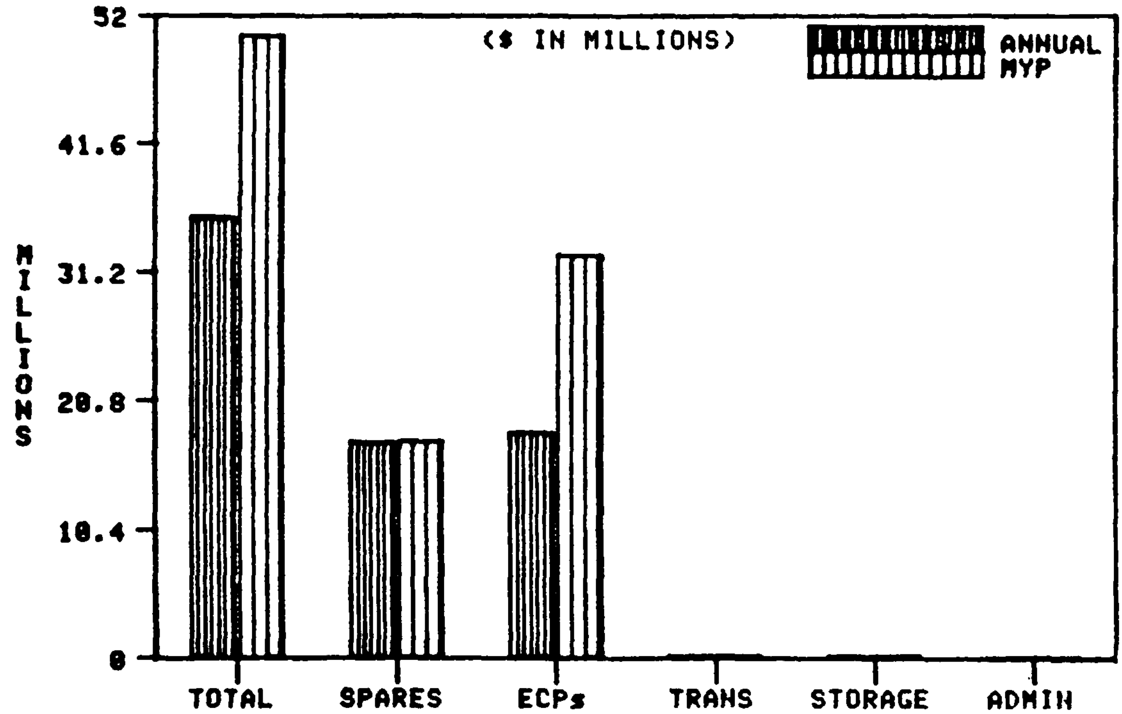


Figure 4. Cost Comparison for Heads Up Display Unit

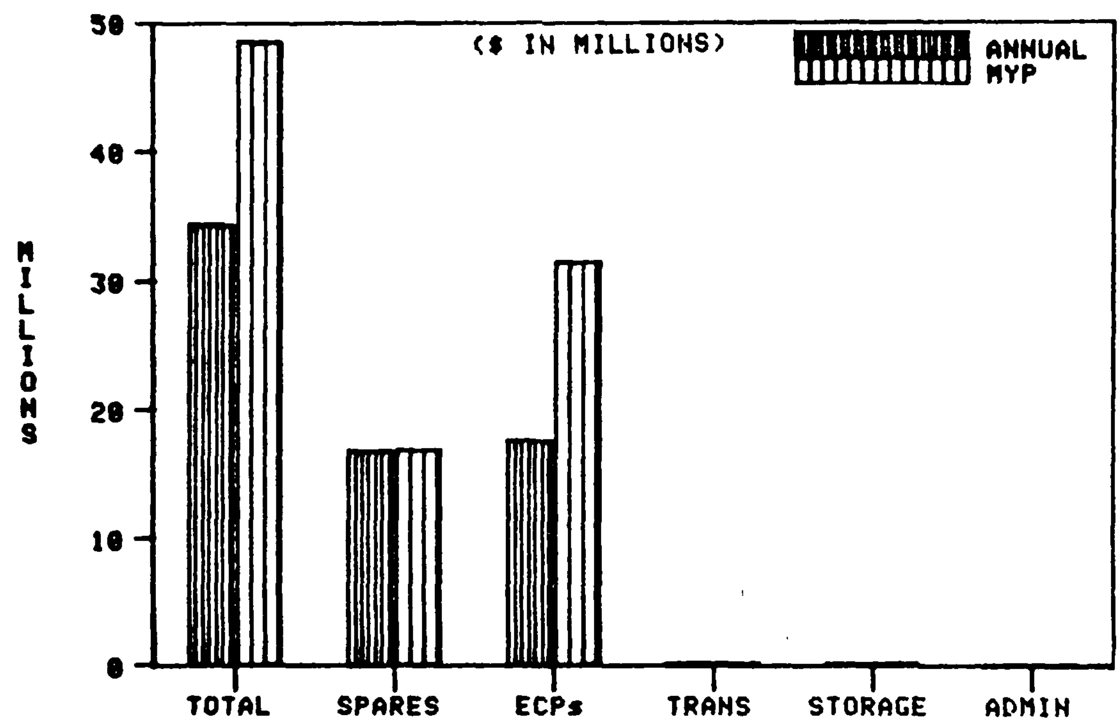


Figure 5. Cost Comparison for Electronic Unit

TABLE 12

Discounted Cost Comparison

Spare Parts		Then-Year Dollars in Millions* Spares	ECPs	Trans	Storage	Admin	TOTAL
ISA Flap	Annual	6.021	1.102	.008	.046	.005	7.182
	MYP	5.501	2.004	.015	.082	.001	7.603
ISA Rudder	Annual	1.616	.316	.002	.012	.005	1.951
	MYP	1.384	.533	.004	.021	.001	1.943
Heads Up Display Unit	Annual	16.757	17.521	.072	.074	.005	34.429
	MYP	16.840	31.489	.130	.128	.001	48.588
Electronic Unit	Annual	17.379	18.172	.072	.074	.005	35.702
	MYP	17.464	32.660	.130	.128	.001	50.383
Power Supply Display	Annual	.423	.141	.005	.016	.005	.590
	MYP	.426	.281	.010	.028	.001	.746
Data Entry Display	Annual	2.220	.831	.010	.031	.005	3.097
	MYP	2.425	1.600	.019	.052	.001	4.097
Enhanced Fire Control Computer	Annual	9.135	1.733	.005	.026	.005	10.904
	MYP	9.831	3.024	.008	.045	.001	12.909
Accessory Drive Gear Box	Annual	.816	.184	.001	.004	.003	1.008
	MYP	.753	.263	.001	.005	.001	1.023
Drive Assembly	Annual	3.831	.725	.005	.026	.005	4.592
	MYP	3.951	1.272	.008	.045	.001	5.277
Angle of Attack Transmitter	Annual	.133	.025	.003	.021	.005	.187
	MYP	.151	.044	.007	.036	.001	.239

TABLE 12 (continued)

Spare Parts		Then-Year Dollars in Millions*					
		Spares	ECPs	Trans	Storage	Admin	TOTAL
GN2 Valve Pack	Annual	.066	.013	.001	.008	.004	.092
	MYP	.065	.021	.002	.012	.001	.101
Rotary Actuator	Annual	.280	.057	.004	.021	.005	.367
	MYP	.330	.100	.007	.036	.001	.474
Command Servo-C	Annual	.049	.010	.001	.005	.004	.069
	MYP	.054	.016	.001	.008	.001	.080
ISA Horizontal Tail	Annual	3.983	.729	.008	.046	.005	4.771
	MYP	4.271	1.325	.015	.082	.001	5.694
Programmable Memory Control	Annual	1.014	.189	.004	.020	.005	1.232
	MYP	1.017	.338	.007	.036	.001	1.399
Power Supply	Annual	.069	.015	.001	.004	.003	.092
	MYP	.050	.022	.001	.006	.001	.080
Multi-Function Display	Annual	1.988	2.301	.034	.034	.005	4.332
	MYP	2.218	4.015	.059	.058	.001	6.351
Programmable Display Generator	Annual	2.276	2.256	.012	.012	.005	4.561
	MYP	2.355	4.305	.022	.022	.001	6.705

* Dollars discounted at 10 percent.

Note: Item characteristics assume estimated acquisition cost and F-16 baseline data.

been performed (17) Next, this information was transferred to Mr. Ed Polasek, Manager of Configuration Management at General Dynamics. He took this information, along with information he knew about planned F-16 updates, and proposed a projected number of ECPs for all 18 parts for the next five years (28). These projected numbers are listed in Table 11.

A sensitivity analysis was ran on each of the 18 parts to see if the number of ECPs would change the MYP decision. Since constant year dollars were used, the inflation factor of 5 percent was deleted from the data file for these runs. For each item, four computations were ran. Only the number of ECPs were allowed to vary. All other F-16 baseline data remained constant except for inflation factors, as mentioned above. In only two cases, the ISA rudder and the accessory drive gear box, would the MYP decision change if no ECPs were projected (see Table 13). However, for the heads up display unit, electronic unit, multi-function display, and the programmable display generator, the cost of the MYP would be reduced by a significant amount. This finding demonstrates that the number of projected ECPs has a major impact on the total cost of the items. Therefore, before a decision is made to procure parts on a multiyear contract, an evaluation must be made to determine if the potential upfront savings is great enough to offset the potential risk of the cost of ECPs. Figures 6 illustrates the ECP cost difference between the MYP and the annual year option for varying numbers of ECPs per year as computed for the ISA flap. As the number of ECPs increase per year, the ECP costs increase for both options. However, the ECP cost gap between the two options widens as

the projected number of ECPs increase. Figures 7 through 9 illustrate similar results for the ISA rudder, heads up display unit and the electronic unit, respectively.

TABLE 13

ECP Sensitivity

(Constant-Year Dollars in Millions)

		Number of ECPs Per Year		
Spare Parts	Projected	0	1	2
ISA Flap	.966	.070	1.797	2.724
ISA Rudder	.125	(.0672)	.2898	.5271
Heads Up Display Unit	15.633	1.812	6.182	9.169
Electronic Unit	16.210	1.877	6.409	9.507
Power Supply Display	.192	.059	.1492	.2282
Data Entry Display	1.000	.322	.891	1.424
Enhanced Fire Control Computer	2.793	1.977	3.644	6.339
Accessory Drive Gear Box	.071	(.0013)	.304	.453
Drive Assembly	1.026	.586	1.347	2.557
Angle of Attack Transmitter	.063	.056	.079	.119
GN2 Valve Pack	.013	.013	.030	.044
Rotary Actuator	.130	.116	.165	.249
Command Servo-C	.015	.016	.026	.049
ISA Horizontal Tail	1.284	.662	1.856	2.423
Programmable Memory Control	.259	.144	.362	.597
Power Supply	(.008)	(.017)	.005	.029
Multi-Function Display	1.836	.220	.734	1.083
Programmable Display Generator	2.353	.187	.713	1.022

Note: Total multiyear procurement cost - total annual procurement cost with varying number of ECPs.

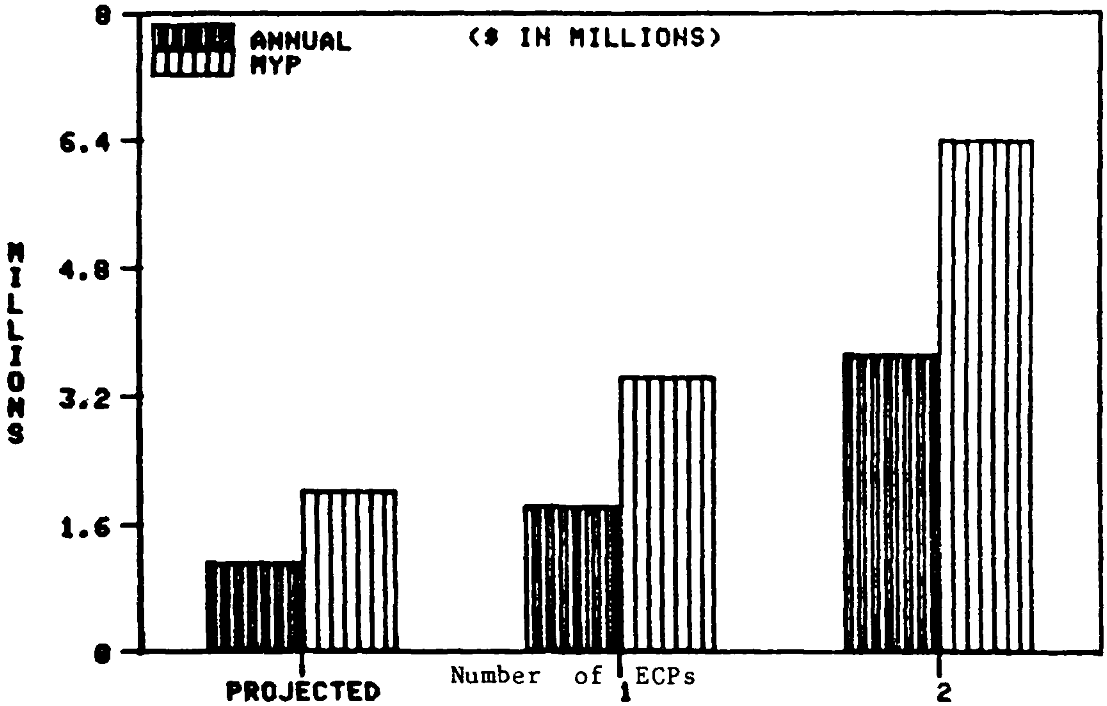


Figure 6. ECP Cost Impact on ISA Flap

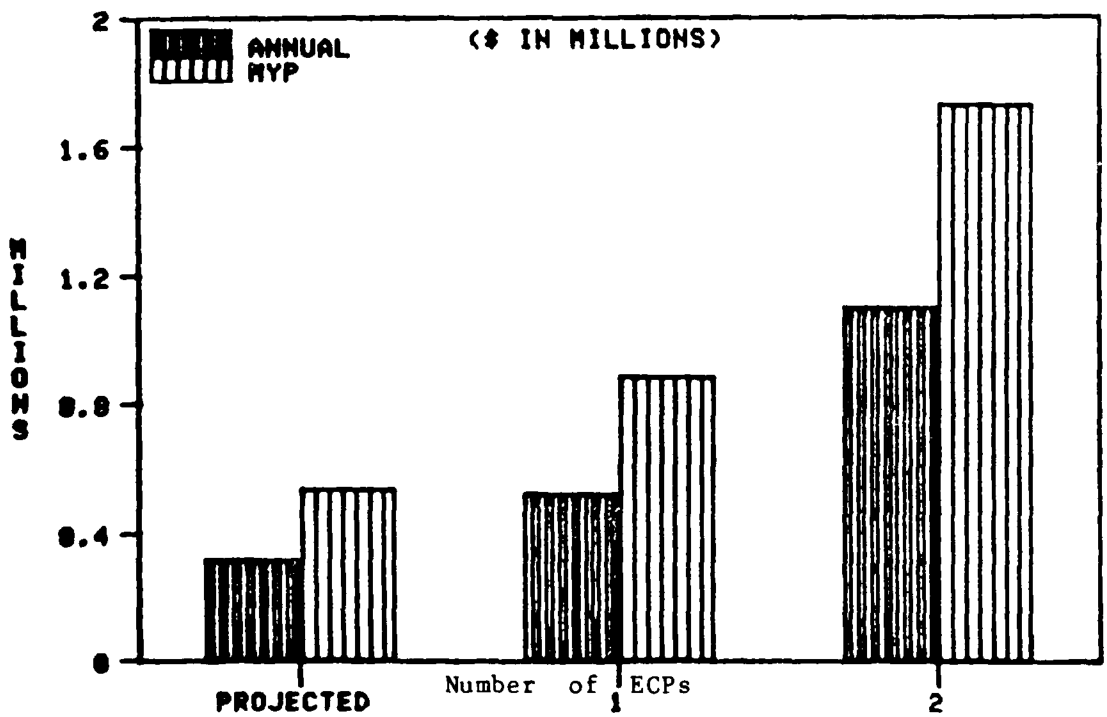


Figure 7. ECP Cost Impact on ISA Rudder

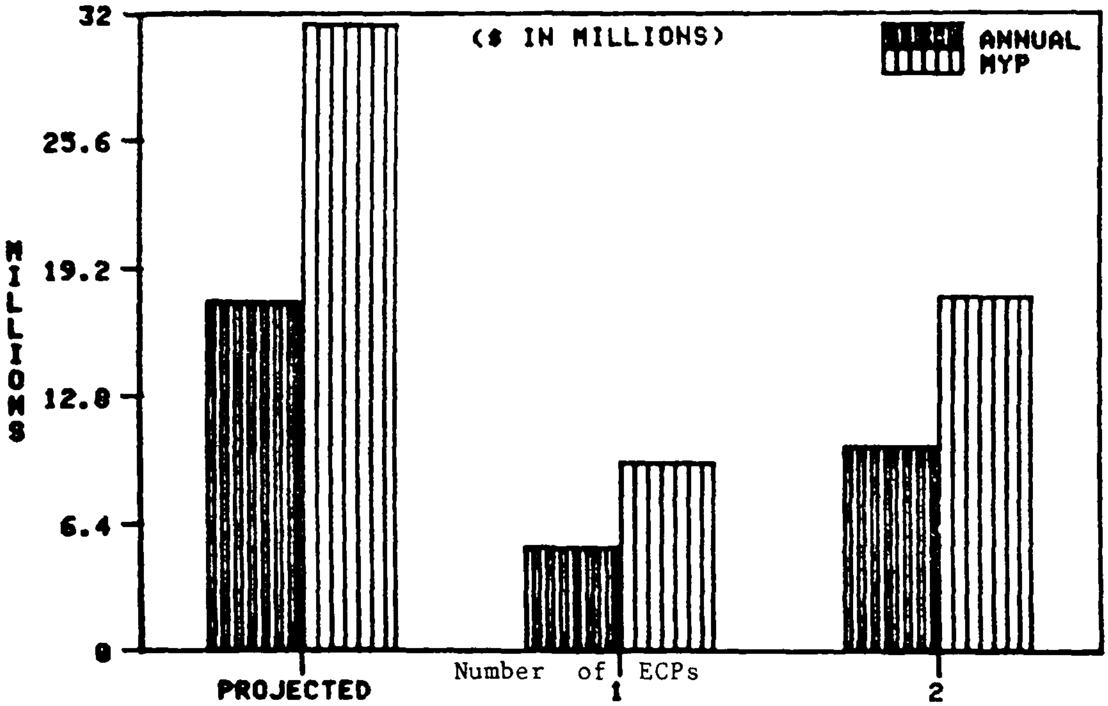


Figure 8. ECP Cost Impact on Heads Up Display Unit

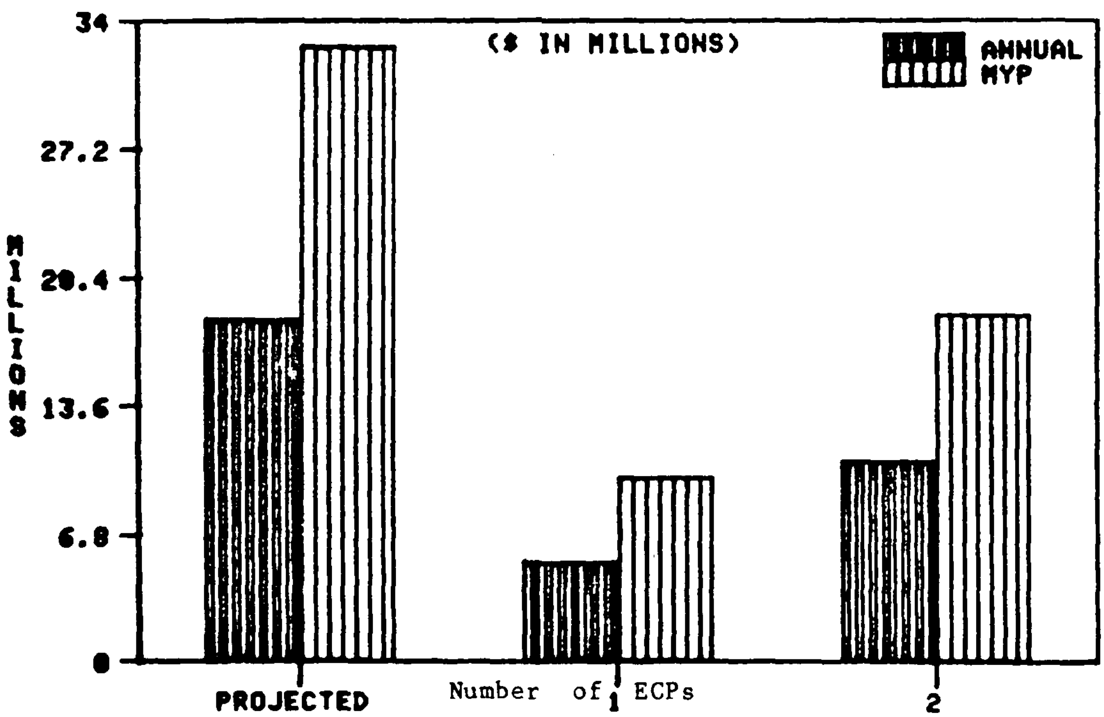


Figure 9. ECP Cost Impact on Electronic Unit

The F-16 baseline data included the projected number of ECPs, and baseline cost was 10 percent of the acquisition price. The 10 percent of acquisition price was an estimate given by Mr. Homer Boyd, Manager of Estimating at General Dynamics, as a reasonable cost per ECP. However, he did point out that the cost of an ECP could range from 0 to 95 percent of the acquisition price. He therefore suggested that for these items a sensitivity analysis be performed using 5, 10, 15, and 20 percent (5). In the four computations ran for each item, only the cost of each ECP was allowed to vary. All other F-16 baseline data remain constant. The results of these computations indicate the change in the projected cost of ECPs does not change the MYP decision (see Table 14). The cost of ECPs under the MYP option is always higher than under the annual year option. However, if the upfront savings realized from a MYP decision is high enough to offset the potential risk of ECP costs, then the MYP option should be accepted.

Research Question Three. Does discounting have an impact on MYP decisions?

As stated in Chapter II, the DOD requires that present value analysis be used when comparing alternatives. Present value takes into consideration the time value of money. The Economic Analysis Procedures Handbook states that a 10 percent discount should be used in all federal programs or projects (10). A cost comparison of all the items computed with a 10 percent discount rate for both an annual year option and a MYP option is shown in Table 12, while Table 15 is an undiscounted cost comparison of all the items. Both tables were computed using then-year dollars. When the items were discounted,

TABLE 14

ECP Cost Sensitivity

(Dollars in Millions)

Spare Parts	Percent of Spares Acquisition 5%	10%	15%	20%
ISA Flap	.475	.902	1.260	1.688
ISA Rudder	.107	.217	.148	.428
Heads Up Display Unit	6.984	13.969	19.953	26.876
Electronic Unit	7.242	14.484	21.726	28.968
Power Supply Display	.070	.140	.194	.326
Data Entry Display	.428	.770	1.231	1.903
Enhanced Fire Control Computer	.6512	1.291	2.090	3.081
Accessory Drive Gear Box	.079	.079	.210	.245
Drive Assembly	.271	.546	.897	1.253
Angle of Attack Transmitter	.009	.018	.030	.047
GN2 Valve Pack	.006	.008	.017	.027
Rotary Actuator	.022	.043	.069	.106
Command Servo-C	.004	.006	.015	.019
ISA Horizontal Tail	.314	.596	.833	1.117
Programmable Memory Control	.076	.149	.225	.341
Power Supply	.006	.007	.014	.025
Multi-Function Display	.160	.309	.485	.691
Programmable Display Generator	.822	1.643	2.466	3.288

Note: Multiyear procurement ECP cost - annual year ECP cost at varying percentages of acquisition cost

only two of the items favored a MYP decision — the ISA rudder and the power supply display. Using undiscounted dollars, seven of the items favor a MYP decision: the ISA flap, ISA rudder, accessory drive gear box, drive assembly, GN2 valve pack, programmable memory control, and power supply. Making a decision on which alternative to choose without discounting the out-year dollars assumes that a dollar today is worth the same in the future. As explained in a multiyear procurement handbook,

TABLE 15

Undiscounted Cost Comparison

		Then-Year Dollars in Millions					
Spare Parts		Spares	ECPs	Trans	Storage	Admin	TOTAL
ISA Flap	Annual	7.144	1.082	.008	.046	.005	8.285
	MYP	5.332	1.943	.014	.079	.001	7.369
ISA Rudder	Annual	1.991	.320	.002	.013	.005	2.331
	MYP	1.417	.546	.004	.021	.001	1.989
Heads Up Display Unit	Annual	21.248	17.717	.073	.075	.005	39.118
	MYP	17.434	32.601	.135	.132	.001	50.303
Electronic Unit	Annual	22.036	18.375	.073	.076	.005	40.565
	MYP	18.081	33.813	.135	.132	.001	52.162
Power Supply	Annual	.511	.154	.006	.018	.005	.694
Display	MYP	.426	.281	.010	.028	.001	.746
Data Entry Display	Annual	2.854	.795	.009	.030	.005	3.693
	MYP	2.355	1.554	.018	.051	.001	3.979
Enhanced Fire Control Computer	Annual	9.135	1.733	.005	.026	.005	10.904
	MYP	9.831	3.024	.008	.045	.001	12.909
Accessory Drive Gear Box	Annual	1.051	.175	.001	.004	.004	1.235
	MYP	.828	.289	.001	.006	.001	1.125
Drive Assembly	Annual	4.561	.702	.005	.026	.005	5.299
	MYP	3.863	1.243	.008	.044	.001	5.159
Angle of Attack Transmitter	Annual	.157	.024	.004	.021	.005	.211
	MYP	.147	.043	.006	.035	.001	.232

TABLE 15 (continued)

Spare Parts		Then-Year Dollars in Millions Spares	ECPs	Trans	Storage	Admin	TOTAL
GN2 Valve Pack	Annual	.089	.013	.001	.008	.005	.116
	MYP	.073	.024	.002	.013	.001	.113
Rotary Actuator	Annual	.356	.054	.004	.021	.005	.440
	MYP	.321	.097	.006	.035	.001	.460
Command Servo-C	Annual	.063	.009	.001	.005	.004	.082
	MYP	.057	.017	.002	.009	.001	.086
ISA Horizontal Tail	Annual	4.725	.715	.008	.046	.005	5.449
	MYP	4.140	1.285	.014	.079	.001	5.519
Programmable Memory Control	Annual	1.188	.180	.003	.021	.005	1.397
	MYP	.974	.324	.006	.035	.001	1.340
Power Supply	Annual	.094	.015	.001	.004	.004	.118
	MYP	.057	.026	.001	.007	.001	.092
Multi-Function Display	Annual	2.654	2.264	.033	.034	.005	4.990
	MYP	2.256	4.084	.060	.059	.001	6.460
Programmable Display Generator	Annual	2.644	2.462	.013	.013	.005	5.137
	MYP	2.245	4.105	.021	.021	.001	6.393

> A future level of expenditure has a smaller present value because of the time value of money." A sum of money on hand today can be invested in interest bearing securities. Its future value, then will be its starting amount plus the interest it will earn up to the future date, compounded on a periodic basis. For example, if $1.00 is invested today in a bond paying 10 percent interest per year, its value one year from today will be $1.10. If that sum is then reinvested at the same rate, its value two years from today will be $1.21. Thus, $1.21 two years from now has a present value (today) of $1.00. (7:33)

Therefore, present value must be considered when choosing between the two options (annual year and MYP).

Internal rate of return (IRR) was added to the model. IRR is defined as "that rate of interest which, when used to discount a future stream of income to its present value, will yield a present value exactly equal to the investment that created the income stream" (7:29). The investment here is the additional cost for the MYP in the first year, and the future income is the out-year cost savings in then-year dollars. Ten of the items were evaluated for IRR using undiscounted dollars. Of the ten items, five had a positive IRR. The following is a list of the items that were selected, along with the internal rate of return for those with positive values:

1.	Power Supply	33.177
2.	ISA Rudder	20.365
3.	GN2 Valve Pack	9.949
4.	Command Servo-C	5.035
5.	Angle of Attack Transmitter	3.341
6.	ISA Horizontal Tail	-
7.	Programmable Display Generator	-
8.	Electronic Unit	-
9.	ISA Flap	-
10.	Multi-Function Display Unit	-

These calculations were made using undiscounted dollars, while all other F-16 baseline data remained constant. The multiyear procurement handbook states that "the criterion for an acceptable MYP candidate should simply be that the internal rate of return shall be positive and greater than zero" (7:30). However, before accepting an item as a good MYP candidate, the total cost of the item must be considered rather than only the acquisition price. The cost of ECPs could more than offset the potential savings.

Research Question Four. How sensitive are the discount rates?

The use of discount dollars versus undiscounted dollars can change the MYP decision. However, the discount rates of 10, 9, 8, and 7 percent has very little impact on the MYP decision on these 18 items. A sensitivity analysis was performed using the above discount rates. All factors were held constant except the discount rate. The discount rate was allowed to vary for the four computations and the inflation factor was deleted. Results of the analysis are shown in Table 16. The table illustrates the difference in total cost between the annual year and MYP options at discount rates. Of the 18 items, only the ISA rudder decision would have changed if the discount rate was lower than 10 percent.

Research Question Five. Does the program scenario change the results of the model?

The results of the model were consistent, although the F-16 program scenario is different from the B-1B scenario. While the F-16 flying hours per aircraft each month is close to the B-1B flying hours per month, the sortie length for the F-16 drops from 5 hours to 1.3

TABLE 16

Discount Rate Sensitivity

(Constant Year Dollars in Millions)

	Rate of Discount			
Spare Parts	10%	9%	8%	7%
ISA Flap	.445	.3247	.199	.070
ISA Rudder	.020	(.015)	(.052)	(.090)
Heads Up Display Unit	14.326	14.005	13.672	13.330
Electronic Unit	14.681	14.358	14.018	13.570
Power Supply Display	.113	.107	.100	.094
Data Entry Display	1.0275	.973	.916	.857
Enhanced Fire Control Computer	4.813	4.646	4.474	4.297
Accessory Drive Gear Box	.124	.103	.079	.056
Drive Assembly	.7309	.654	.574	.492
Angle of Attack Transmitter	.051	.048	.046	.043
GN2 Valve Pack	.014	.013	.011	.010
Rotary Actuator	.088	.083	.077	.070
Command Servo-C	.015	.014	.013	.012
ISA Horizontal Tail	.853	.781	.706	.630
Programmable Memory Control	.187	.166	.145	.123
Power Supply	(.009)	(.010)	(.012)	(.013)
Multi-Function Display	1.857	1.817	1.777	1.736
Programmable Display Generator	2.024	1.982	1.937	1.891

Note: Total MYP cost - annual year total cost at varying discount rates

hours (20). The number of aircraft considered in this study is 720 versus 99 for the B-1B. The number of bases that these F-16 aircraft will be deployed to is 15, and those bases are both stateside and overseas, whereas the B-1Bs will only be deployed to 4 stateside bases. The model can accommodate different program scenarios. However, the run time for the B-1B data before the model was modified was approximately nine minutes for each item, but once the model was modified and F-16 data was ran, the run time for each item increased to approximately two hours. The CPU time alone was about 20 minutes.

Because models hosted on a timesharing system normally go into a cue and are run overnight, the turn-around time was very slow.

Research Question Six. If a discount rate of 10 percent were applied to the B-1B items, would the MYP decision change?

A sample of three items, the electronic display unit, the power supply C & D, and the multi-function display, were chosen from the eight B-1B items used in the development of the MYP simulation model. A cost comparison of these items using undiscounted dollars is shown in Table 17, while the comparison using a discount rate of 10 percent is shown in Table 18. In each case the MYP costs are the same because this model assumes that for the MYP option all items are purchased in the first year. Before the dollars were discounted, all three items favored a MYP decision. However, if the DOD-prescribed 10 percent discount rate had been used, the annual year option would have been lower than the MYP option. Thus, if evaluating only the economic benefits of these items, the MYP decision should have been different. However, time will determine if these items were good MYP candidates.

In order to make the right MYP decision, many factors must be considered. First, all six of the MYP criteria stated in the FAR must be satisfied. Even though an item may have a stable design, the potential savings must be high enough to justify the risk associated with a MYP decision. MYP will not solve all the acquisition problems, but there are a number of ways MYP can aid both the government and the contractor:

1. Reduce cost
2. Reduce administrative burden
3. Improve industrial surge capability

TABLE 17

Sample Undiscounted Cost Comparison

Spare Parts		Then-Year Dollars in Millions					
		Spares	ECPs	Trans	Storage	Admin	TOTAL
Electronic	Annual	1.098	.296	.001	.004	.005	1.404
Display Unit	MYP	.776	.517	.002	.008	.001	1.304
Power Supply	Annual	.151	.043	.001	.002	.003	.200
C & D	MYP	.108	.072	.001	.004	.001	.186
Multi-Function	Annual	.942	.262	.004	.013	.004	1.225
Display	MYP	.669	.446	.007	.022	.001	1.145

Note: B-1B item characteristics assume predicted cost, D220 MTBD, 25 percent savings on MYP first year acquisition price, and other baseline data. (4:45)

TABLE 18

Sample Discounted Cost Comparison

Spare Parts		Then-Year Dollars in Millions					
		Spares	ECPs	Trans	Storage	Admin	TOTAL
Electronic	Annual	.896	.296	.001	.004	.005	1.202
Display Unit	MYP	.776	.517	.002	.008	.001	1.304
Power Supply	Annual	.1250	.043	.001	.002	.003	.174
C & D	MYP	.108	.072	.001	.004	.001	.186
Multi-Function	Annual	.773	.262	.004	.013	.004	1.056
Display	MYP	.670	.446	.007	.022	.001	1.146

Note: B-1B item characteristics assume predicted cost, D220 MTBD, 25 percent savings on MYP first year acquisition price, and other baseline data. (4:45)

4. Help stabilize the work force
5. Increase productivity (3:3)

The significant cost drivers that were identified have been confirmed as significant by this study through literature review and numerous interviews. In addition, F-16 data was ran through the model to verify that the model could be ran using a different program scenario. Many runs were made with little variation in the results. The results of a simulation model cannot prove that a system actually performs in the manner indicated by the results. However, the model can serve as an aid to the decision maker in making the right MYP decision.

V. Conclusions and Recommendations

Conclusions

This thesis validated and expanded the MYP simulation model developed by Bodnar in 1985. The researcher used two separate approaches to validate the model. The first approach was to identify key cost drivers associated with making a MYP decision and ensure that these costs were included in the model. The two significant cost drivers associated with a MYP decision are: 1) the acquisition savings due to buying material in larger quantities, and 2) the potential ECP cost. Other cost elements considered in this thesis include transportation, storage, and administration costs. These costs added very little to the overall cost of the items. This conclusion is supported by the IMs at OO-ALC (24; 26; 49). They reported that these cost elements are not even considered in a MYP decision. The second approach in validating the MYP simulation model involved acquiring like data on 18 F-16 spares that were similar to the eight B-1B spares used to develop the MYP simulation model. The items ranged from simple and moderate to complex and were of low and high dollar values. The F-16 data was ran through the model and results supported the fact that OO-ALC chose the annual year contracting strategy on the majority of these items (16). This was accomplished through research of current literature and interviews.

Six research questions were proposed and the results are outlined in Chapter IV. The following paragraph provides a brief summary of those findings. Research showed that under the MYP option, both the

acquisition savings due to large quantity buys of material up-front and the potential cost of ECPs are the significant cost drivers.

The model was expanded by adding both discounting and IRR to account for the time value of money. The DOD prescribes that a 10 percent discount rate be used for all federal programs and projects when comparing alternatives. The DOD also requires that an exhibit showing internal rate of return be included in the MYP submission package.

The interview process identified that the projected number of ECPs have a significant impact on MYP decisions. This is also supported by the MYP model. However, as defined in the Federal Acquisition Regulation, before an item is considered as a MYP candidate it must have a stable design.

The model assumes all items for the MYP option are bought in the first year. Adding discounting to the model effects only the annual year prices. A 10 percent discount rate was used as the baseline because the DOD requires this rate be used in ranking alternatives. Year one was used as base year in this model and dollars were discounted for years two through five. Taking into consideration the time value of money, there was a significant impact on the MYP decision for several spare parts. However, the discount rate between 10 and 7 percent had little impact on the MYP decision. If discounting were used in developing the original MYP model, at least three of the B-1B items would have received an unfavorable MYP decision, the electronic unit, power supply C & D, and multi-function display.

This research shows that certain data needs to be readily available to the decision makers and analysts in order to make an appropriate and timely MYP decision. This data includes: 1) the criteria for selecting MYP candidates; 2) a proposed MYP and annual year estimate of acquisition cost of an item; 3) the projected number and cost of ECPs; 4) a program scenario; and 5) reliability and maintainability data. HQ AFLC is in the process of establishing a system that will track the number of parts that are on MYP contract. This will provide a database for making future MYP decisions.

The purpose of this model is to aid the decision maker in choosing appropriate MYP candidates in a timely manner. This model provides the method to evaluate both the benefits and the risk of accepting a MYP option.

Recommendations for Future Research

1. Implement a tracking system for ECPs to specific spare parts. The data base could be helpful in estimating potential ECPs for new items.

2. Coding of items that have been procured by a MYP. This would provide a way of monitoring whether the MYP decision was appropriate and provide data for choosing of similar parts.

3. Convert the MYP simulation model to a personal computer mode (PC). This would be beneficial to the decision-makers to have models at their fingertips instead of on a timesharing system as it is today.

Appendix A. Discounted Cost Comparison

This table displays the cost comparison of all 18 items in constant-year dollars. When using constant year dollars, only power supply favored the MYP option. However, when using then-year dollars (Table 12), both the ISA rudder and the power supply favored the MYP option.

		Constant-Year Dollars in Millions*					
Spare Parts		Spares	ECPs	Trans	Storage	Admin	TOTAL
ISA Flap	Annual	5.474	1.102	.008	.046	.005	6.635
	MYP	5.501	2.004	.015	.082	.001	7.603
ISA Rudder	Annual	1.481	.316	.002	.012	.005	1.816
	MYP	1.384	.533	.004	.021	.001	1.943
Heads Up Display Unit	Annual	15.283	17.521	.072	.074	.005	34.955
	MYP	16.840	31.489	.130	.128	.001	48.588
Electronic Unit	Annual	15.850	18.172	.072	.074	.005	34.173
	MYP	17.464	32.660	.130	.128	.001	50.383
Power Supply Display	Annual	.386	.141	.005	.016	.005	.553
	MYP	.426	.281	-.010	.028	.001	.746
Data Entry Display	Annual	2.220	.831	.009	.031	.005	3.096
	MYP	2.425	1.600	.019	.052	.001	4.097
Enhanced Fire Control Computer	Annual	8.347	1.733	.005	.026	.005	10.116
	MYP	9.831	3.024	.008	.045	.001	12.909
Accessory Drive Gear Box	Annual	.761	.184	.001	.004	.003	.953
	MYP	.753	.263	.001	.005	.001	1.023
Drive Assembly	Annual	3.491	.725	.005	.026	.005	4.252
	MYP	3.951	1.272	.008	.045	.001	5.277
Angle of Attack Transmitter	Annual	.121	.025	.004	.021	.005	.176
	MYP	.151	.044	.007	.036	.001	.239

Spare Parts		Spares	ECPs	Trans	Storage	Admin	TOTAL
		Constant-Year Dollars in Millions*					
GN2 Valve Pack	Annual	.062	.013	.001	.008	.004	.088
	MYP	.065	.021	.002	.012	.001	.101
Rotary Actuator	Annual	.257	.057	.004	.021	.005	.344
	MYP	.330	.099	.007	.036	.001	.473
Command Servo-C	Annual	.045	.010	.001	.005	.004	.065
	MYP	.054	.016	.004	.008	.001	.083
ISA Horizontal Tail	Annual	3.621	.729	.008	.046	.005	4.409
	MYP	4.271	1.325	.015	.082	.001	5.694
Programmable Memory Control	Annual	.921	.189	.004	.020	.005	1.139
	MYP	1.017	.338	.007	.036	.001	1.399
Power Supply	Annual	.064	.015	.001	.004	.003	.087
	MYP	.050	.022	.001	.006	.001	.080
Multi-Function Display	Annual	1.958	2.301	.034	.034	.005	4.332
	MYP	2.218	4.015	.059	.058	.001	6.351
Programmable Display Generator	Annual	2.067	2.256	.012	.012	.005	4.352
	MYP	2.355	4.305	.022	.022	.001	6.705

* Dollars discounted at 10 percent.

Note: Item characteristics assume estimated acquisition cost and F-16 baseline data.

Appendix B. Model Input and Output

This appendix displays an input file and output of the model which serves to illustrate the operation of the MYP simulation model. The example is using data collected on the heads up display unit. A sensitivity analysis on the number of ECPs per year is shown. The four different cost breakdowns are a result of the varying numbers of ECPs per year. The data used in the simulation are displayed in the output with the exception of transportation costs, administration costs, storage costs, and shipping costs. These costs can be modified in the model.

INPUT

Program Code		Description
0005 JUL 1986	-	Current date
0010 F-16	-	Program
0020 28, 6 1.3	-	Flying hours per month/sortie length
0030 87 5 5	-	Year start/report quit
0040 1.0 1.05 1.10 1.15 1.20	-	Inflation factors
0500 1.0 .909 .826 .751 .683	-	Discount factors
0060 53	-	Months of delivery
0700 0 0 0 0 0 15	-	Year 1
0080 15 15 15 15 15 15 15 15 15 15 15 15 15 15 15 15 15 15	-	Year 2
0090 15 15 15 15 15 15 15 15 15 15 15 15 15 15 15 15 15 15	-	Year 3
0100 15 15 15 15 15 15 15 15 15 15	-	Year 4
0110 15	-	Number of bases
0120 36	-	Base 1
0130 72	-	Base 2
0140 72	-	Base 3
0150 72	-	Base 4
0160 54	-	Base 5
0170 24	-	Base 6
0180 24	-	Base 7
0190 36	-	Base 8
0200 72	-	Base 9
0210 54	-	Base 10
0220 72	-	Base 11
0230 48	-	Base 12
0240 18	-	Base 13
0250 72	-	Base 14
0260 24	-	Base 15
0270 4	-	Number of computations
0280 EFCC 000 438 .98 0 113265. 0.0 1 110461. 11327. 1 0 1 0 1	-	Item data
0281 EFCC 000 438 .98 0 113265. 0.0 1 110461. 11327. 1 1 1 1 1	-	Item data
0282 FMFD 000 438 .98 0 113265. 0.0 1 110461. 11327. 2 2 2 2 2	-	Item data
0283 FMFD 000 438 .98 0 113265. 0.0 1 110461. 11327. 0 0 0 0 0	-	Item data

OUTPUT

JUL 1986

INFLATION FACTORS

1	2	3	4	5
1.00	1.05	1.10	1.15	1.20

DISCOUNT FACTORS

1	2	3	4	5	
1.000	.909	.826	.751	.683	

F-16 DELIVERY SCHEDULE

YR	J	F	M	A	M	J	J	A	S	O	N	D	
87	0	0	0	0	0	15	15	15	15	15	15	15	105
88	15	15	15	15	15	15	15	15	15	15	15	15	180
89	15	15	15	15	15	15	15	15	15	15	15	15	180
90	15	15	15	15	15	15	15	15	15	15	15	15	180
91	15	15	15	15	15	0	0	0	0	0	0	0	75

TOTAL = 720

BASE DEPLOYMENT SCHEDULE

BASE #	# OF A/C
1	36
2	72
3	72
4	72
5	54
6	24
7	24
8	36
9	72
10	54
11	72
12	48
13	18
14	72
15	24

LRU RELIABILITY AND MAINTAINABILITY DATA

		FAIL RATE	NRTS RATE	# OF SRUS	ANNUAL PRICE	COND RATE	QPA	MYP PRICE	ECP COST	ECP PROFILE 1 2 3 4 5
1EFCC	000	438	.98	0	113265.	0.	1	110461.	11327.	1 0 1 0 1
2EFCC	000	438	.98	0	113265.	0.	1	110461.	11327.	1 1 1 1 1
3EFCC	000	438	.98	0	113265.	0.	1	110461.	11327.	2 2 2 2 2
4EFCC	000	438	.98	0	113265.	0.	1	110461.	11327.	0 0 0 0 0

OUTPUT

```
                END OF YEAR STATUS REPORT
                          1992
             --------------------------------


     .6362  MIL. FLYING HOURS             .7008 MIL. OPERATING HOURS
  490176 SORTIES COMPLETED

              -------------------------------------------
                     LRU REMOVAL DATA
     5829 LRUS REMOVED  DISTRIBUTED AMONG THE   4  THUS
 1471    1383    1488    1487
             -----------------------------------------------------
                      FINAL COST BREAKDOWN FOR      EFCC      000
                                    ANNUAL                   MYP
             LRU SPARES      =  $          9.1352  $         9.8310
             SRU SPARES      =  $          0.      $         0.
           LRU ECP COST      =  $          1.7330  $         3.0243
           SRU ECP COST      =  $          0.      $         0.
           TRANSPORTATION    =  $           .0046  $          .0080
            STORAGE          =  $           .0261  $          .0445
           ADMINISTRATION    =  $           .0050  $          .0010
                                 ---------------  ---------------
          TOTAL  COST        =  $         10.9039  $        12.9088

                      SPARES  BUILDUP BY YEAR
  YEAR          1        2        3        4        5          TOTAL
             ______   ______   ______   ______   ______       ______
                13       24       14       20       18           89
              ---------------------------------------------------------
```

Appendix C. Program Listing

The following pages are a listing of the SIMSCRIPT programming code for the MYP simulation model.

```
##S,R(X1)
$      IDENT   WP3056,BIN15 -     WARDLEY    MYP  CMSEV
$      LIMITS  50,50K,,10K
$      LOWLOAD
$      OPTION  FORTRAN,NOMAP
$      LIBRARY SL
$      PROGRAM RLHS
$      LIMITS  50,50K,,10K
$      PRMFL   H*,R,R,CACI/SIM2.5
$       FILE    *1
$       FILE    *2
$       FILE    B*,B1S
      PREAMBLE
      NORMALLY MODE IS INTEGER
      EVENT NOTICES INCLUDE
        DEPLOYMENT,
       INSPECTION,
      MULTI,
      ECP,
     ADMIN,
       REPORT,
       END.OF.YRSTATS
       EVERY LRUREPAIR HAS A PART
       EVERY SRUREPAIR HAS A A AND A C
       DEFINE LRUCHECK AS A ROUTINE WITH 1 VALUE
      DEFINE SRUCHECK AS A ROUTINE WITH 2 VALUES
       DEFINE B,PLANES,ICOUNT,LCNT,REMLRU,
          ILRU,DLRU,INT.HRS,DEP.HRS,MAX,E.TOT AS VARIABLES
       DEFINE YR.START,YR.REPORT,YR.QUIT,NO.OF.BASES AS VARIABLES
      DEFINE MIL AS A VARIABLE
       DEFINE ORATE,IRATE,DRATE,ICOST,DCOST,
           SORTIE,FHP,TBS,FHT,OPT    AS REAL VARIABLES
       DEFINE BASEQTY,SE.RQMT,LREM,SCNT,LRU,SLRU,PQ,
       SREM,NLRU,LQPA,ADM AS 1-DIMENSIONAL ARRAYS
     DEFINE ANECP,AN.SRU,MY.ECP,MYSRU,TLCOST,TSCOST,TRANS,TRMY,
      CSMY,CMY,STOR,STMY   AS 1-DIMENSIONAL REAL ARRAYS
        DEFINE NSECP AS A 3-DIMENSIONAL ARRAY
       DEFINE REMSRU,SRU,NSRU,SSRU,NLECP,YRLRU AS 2-DIMENSIONAL
        DEFINE SRUPROB,SCOND,SCOST,CSECP,SMYP              ARRAYS
       AS 2-DIMENSIONAL REAL ARRAYS
      DEFINE SE.COST,LCOST,NRTS,LCOND,LRUPROB,CLECP,MYP,
         INFLA, DISC  AS 1-DIMENSIONAL REAL ARRAYS
     DEFINE PRGM AS AN ALPHA VARIABLE
    DEFINE NAME AS A 2-DIMENSIONAL ALPHA ARRAY
           DEFINE TCOST,TMYPC AS 1-DIM REAL ARRAYS
     DEFINE YR.COUNT AS A VARIABLE
    DEFINE N,X  AS INTEGER    VARIABLES
       DEFINE TLCST AS A 2-DIMENSIONAL ARRAY
      END
    MAIN
```

```
      RESERVE SRUPROB,REMSRU,NSRU,SRU,SSRU,NLECP,SCOST,
      CSECP,SMYP,SCOND,YRLRU AS 5 BY 100
      RESERVE LRUPROB,CLECP,LREM,NPTS,SCNT.LRU,SLRU,LCOST,
       LCOND,SREM,MYP,INFLA, DISC AS 30
   RESERVE  ANECP,AN.SRU,MY.FAS 30
       RESERVE NSECP AS 5 BY 100 BY 5
     RESERVE NLRU,LQPA,ADM AS 30
      RESERVE PQ AS 132
      RESERVE BASEQTY AS 30
       RESERVE SE.COST.SE.RQMT AS 3
    DEFINE SNAME AS A 1-DIMENSIONAL ALPHA ARRAY
     RESERVE NAME AS 30 BY 2
     RESERVE SNAME AS 2
     DEFINE DATE AS A 1-DIMENSIONAL ALPHA ARRAY
        RESERVE DATE AS 2
           RESERVE TCOST,TMYPC AS 5
                RESERVE TLCST AS 5 BY 100
     LET MIL = 1000000
     READ DATE(1),DATE(2)  WRITE DATE(1),DATE(2) AS B 60,2 A 5,/
  ''  READ SE.COST(1),SE.COST(2),SE.COST(3)
     READ PRGM
     READ FHP,SORTIE,DRATE,IRATE,DRATE
     READ YR.START,YR.REPORT,YR.QUIT
     FOR I = 1 TO YR.QUIT   READ INFLA(I)
   SKIP 2 LINES  PRINT 2 LINES THUS
                            INFLATION FACTORS
       1         2         3         4         5
     FOR I = 1 TO YR.QUIT  WRITE INFLA(I)  AS
      S 5,D(4,2)
     FOR I = 1 TO YR.QUIT   READ DISC(I)
   SKIP 2 LINES  PRINT 2 LINES THUS
                            DISCOUNT FACTORS
       1         2         3         4         5
     FOR I = 1 TO YR.QUIT  WRITE DISC(I)  AS
      S 5,D(5,3)
     READ MAX  FOR I = 1 TO MAX READ PQ(I)
    LET YR.COUNT = 1
     SKIP 3 LINES  PRINT 2 LINES WITH PRGM THUS
                   ****** DELIVERY SCHEDULE
 YR    J    F    M    A    M    J    J    A    S    O    N    D
       LET CY = YR.START     LET J = 1
    FOR K = 1 TO ((MAX + 11) / 12) DO
     WRITE CY AS I 4  LET JJ = J + 11
    FOR I = J TO JJ ADD PQ(I) TO TOT
    FOR I = J TO JJ WRITE PQ(I) AS (12) I 4
    WRITE TOT AS B 52,I 4,/ ADD TOT TO TOTAL
                LET TOT = 0
    LET CY = CY + 1   LET J = J + 12
       LOOP
     WRITE TOTAL AS B 46,"TOTAL =",I 4,/
     ''
     READ NO.OF.BASES  FOR I = 1 TO NO.OF.BASES  READ BASEQTY(I)
    SKIP 1 LINE   PRINT 2 LINES  THUS                     BASEQTY(I-1)
                        BASE DEPLOYMENT SCHEDULE
   BASE #    # OF A/C
          FOR I = 1 TO NO.OF.BASES WRITE I,BASEQTY(I) AS
                     I 6,I 10,/
         FOR I = 2 TO NO.OF.BASES LET BASEQTY(I) = BASEQTY(I) +
     LET B = 1   LET SE.RQMT(1) = 1  LET SE.RQMT(2) = 1
     ''- - - - - - SCHEDULE INSPECTIONS
```

```
    FOR I = 1 TO MAX DO
     IF FQ(I) = 0  JUMP AHEAD  ELSE
    LET FDAYS = 30.42 / FQ(I)
    FOR J = 1 TO FQ(I) SCHEDULE AN INSPECTION IN
    (FDAYS * J)+(30.42 * (I - 1)) + ((SORTIE / FHP)
                    * 30.42) DAYS
    FOR J = 1 TO FQ(I)
    SCHEDULE A DEPLOYMENT IN (FDAYS * J) + 30.42 * (I -1) DAYS
     HERE   LOOP
     START NEW PAGE   PRINT 4 LINES THUS
                    LRU RELIABILITY AND MAINTAINABILITY DATA
                                                             ECP
  FAIL   NRTS   # OF   ANNUAL   COND   QPA   MYP    ECP     PROFILE
  RATE   RATE   SRUS   PRICE    RATE         PRICE  COST    1 2 3 4 5
  READ LCNT FOR I = 1 TO LCNT DO
  READ NAME(I,1),NAME(I,2),LRU(I),NRTS(I),SCNT(I),LCOST(I),LCOND(I),
LQPA(I),MYP(I),CLECP(I),NLECP(I,1),NLECP(I,2),NLECP(I,3),NLECP(I,4),
NLECP(I,5)
 WRITE I,NAME(I,1),NAME(I,2),LRU(I),NRTS(I),SCNT(I),LCOST(I),
 LCOND(I),LQPA(I),MYP(I),CLECP(I),NLECP(I,1),NLECP(I,2),
 NLECP(I,3),NLECP(I,4),NLECP(I,5)
AS I 2,2 A 6,I 6,S 1,D(4,2),S 1,I 4,S 1,D(8,0),S 3,D(4,2),S 1,I 3,
     D(8,0),D(7,0),5 I 2,/
    LET LRUPROB(I) = SORTIE / LRU(I) * LQPA(I)
      LOOP
         FOR X = 1 TO N DO
                         LET TCOST(X)- = YRLRU(X,1)*LCOST(1)
                        ' LET TMYPC(X) = YRLLRU(X,1)*MYP(1)
         LOOP  '' X TIMES
 ''START NEW PAGE   PRINT 2 LINES  THUS
 '' LRU   FAIL    ANNUAL  COND   MYP   ECP   ECP PROFILE
 ''IDENT  RATE    PRICE   RATE   PRICE COST  1 2 3 4 5
FOR I = 1 TO LCNT  DO
FOR J = 1 TO SCNT(I)   DO
 READ SNAME(1),SNAME(2),SRU(I,J),SCOST(I,J),SCOND(I,J),SMYP(I,J),
 CSECP(I,J),NSECP(I,J,1),NSECP(I,J,2),NSECP(I,J,3),NSECP(I,J,4),
   NSECP(I,J,5)
WRITE J,SNAME(1),SNAME(2),I,SRU(I,J),SCOST(I,J),SCOND(I,J),SMYP(I,
CSECP(I,J),NSECP(I,J,1),NSECP(I,J,2),NSECP(I,J,3),NSECP(I J,4),  J),
NSECP(I,J,5)
  AS I 2,S 2,2 A 6,S 2,I 4,S 3,I 5,S 2,D(8,0),S 2,D(4,2),
  D(8,0),D(6,0),5 I 2,/
 LET SRUPROB(I,J) = LRU(I) / SRU(I,J)
    LOOP
          LOOP
    LET TRS = ((30.42 * 24) / (FHP / SORTIE) / 24)
    SCHEDULE A ECP IN 365 DAYS
    SCHEDULE A MULTI IN 365 * YR.QUIT DAYS
    SCHEDULE A ADMIN IN 365 * YR.QUIT DAYS
  SCHEDULE A REPORT IN 365 * YR.REPORT DAYS
    SCHEDULE A END.OF.YRSTATS IN 366 * YR.QUIT DAYS
    CALL ORIGIN.R(1,1,YR.START)
    START SIMULATION
     END
 ''
 '' ***********************************************
   EVENT DEPLOYMENT
   ADD 1 TO PLANES
    IF PLANES > BASEQTY (B) ADD 1 TO SE.RQMT (1) ADD 1 TO SE.RQMT
      ADD 1 TO B                                                (2)
```

```
   ALWAYS  RETURN   END
''
'' ************************************************
  EVENT INSPECTION
   ADD 1 TO ICOUNT  ADD SORTIE TO FHT ADD  SORTIE*1.1 TO OPT
     FOR I = 1 TO LCNT  DO
  IF RANDOM.F(9) < LRUPROB(I) GO TO 'REMOVE.LRU' ELSE  JUMP AHEAD
'REMOVE.LRU'
   ADD 1 TO LREM(I)  ADD 5 TO INT.HRS  ADD 1 TO REMLRU
   PERFORM LRUCHECK(I)
   IF RANDOM.F(5) < NRTS(I) GO TO 'DEPOT.REPAIR'  ELSE
         GO TO 'IREPAIR'
'IREPAIR'
     SCHEDULE AN LRUREPAIR(I) IN 4 DAYS
    ADD 1 TO ILRU
     ADD 4 TO INT.HRS
   FOR J = 1 TO SCNT(I)  DO
        IF RANDOM.F(8) < SRUPROB(I,J)
           ADD 1 TO SREM(I)
           ADD 1 TO REMSRU(I,J)
           ADD 10 TO DEP.HRS
           PERFORM SRUCHECK(I,J)
''         ADD 10 TO TRANS(I)
           SCHEDULE AN SRUREPAIR(I,J) IN 54 DAYS
 ALWAYS  LOOP
   JUMP AHEAD
'DEPOT.REPAIR'
     S
      ADD 1 TO DLRU
      ADD 4 TO DEP.HRS
''    ADD 30 TO TRANS(I)
     FOR J = 1 TO SCNT(I)   DO
     IF RANDOM.F(8) < SRUPROB(I,J)
        ADD 1 TO SREM(I)
        ADD 1 TO REMSRU(I,J)
        ADD 10 TO DEP.HRS
        PERFORM SRUCHECK(I,J)
        SCHEDULE AN SRUREPAIR(I,J)  IN 40 DAYS
  ALWAYS  LOOP
      HERE   LOOP
     SCHEDULE AN INSPECTION IN TBS DAYS
      RETURN  END
''
'' ************************************************
 SUBROUTINE LRUCHECK(NUM)
        SUBTRACT 1 FROM NLRU(NUM)
        IF NLRU(NUM) < 0 ADD 1 TO SLRU(NUM) ADD 1 TO NLRU(NUM)
     ADD LCOST(NUM)*INFLA(YR.COUNT)*DISC(YR.COUNT)  TO TLCOST(NUM)
     ADD LCOST(NUM)*INFLA(YR.COUNT)*DISC(YR.COUNT)  TO TLCST(YR.
       ADD 1 TO YRLRU(YR.COUNT,NUM)                    COUNT,NUM)
       ALWAYS  RETURN  END
''
'' ************************************************
  EVENT   LRUREPAIR(PART)
      IF RANDOM.F(1) > LCOND(PART)   ADD 1 TO NLRU(PART)
    ALWAYS   RETURN   END
''
   ************************************************
   SUBROUTINE SRUCHECK(I,J)
     SUBTRACT 1 FROM NSRU( TO SSRU(I,J) ADD 1 TO NSRU(I,J)
   ADD SCOST(I,J)*INFLA(YR.COUNT)*DISC(YR.COUNT)  TO TSCOST(I)
```

```
          ALWAYS    RETURN*******************************************
     EVENT SRUREPAIR(A,C)
        IF RANDOM.F(1) > SCOND(A,C)    ADD 1 TO NSRU(A,C)
     ALWAYS    RETURN   END
  '
  '  ************************************************
     EVENT REPORT
       START NEW PAGE  DEFINE TOT.COST AS A REAL VARIABLE
     DEFINE TOT.MYP AS A REAL VARIABLE
   DEFINE INT AS A REFINE SE1,SE2 AS REAL VARIABLES
     DEFINE P,U AS REAL VARIABLES
         DEFINE FF AS 1-DIMENSIONAL REAL ARRAY
      RESERVE FF(*) AS YR.REPORT
       ADD YR.REPORT TO YR.START
     SKIP 1 LINE PRINT 3 LINES WITH YR.START + 1900    THUS
                END OF YEAR STATUS REPORT
                       *****
            --------------------------------
       SKIP 2 LINES
        PRINT 2 LINES WITH FHT/MIL, OPT/MIL, ICOUNT    THUS
   *****.****  MIL. FLYING HOURS    ******.**** MIL. OPERATING
                                                          HOURS
    ****** SORTIES COMPLETED
    SKIP 1 LINE  PRINT 3 LINES WITH REMLRU,LCNT  THUS
          ------------------------------------------
                     LRU REMOVAL DATA
      ***** LRUS REMOVED  DISTRIBUTED AMONG THE ***  THUS
     FOR I = 1 TO LCNT  WRITE LREM(I) AS I 7
  ''SKIP 1 LINE  PRINT 3 LINES  WITH ILRU, DLRU  THUS
  ''                LRU REPAIR ACTIVITY
  ''      ******* LRUS REPAIRED AT INTES REPAIRED AT DEPOT LEVEL
  ''        SKIP 1 LINE  PRINT 2 LINES  THUS
  ''        ------------------------------------------
  ''                  SRU REMOVAL DATA
  ''FOR I = 1 TO LCNT DO
  '             PRINT 1 LINE WITH I,SREM(I)    THUS
  ''LRU NUMBER *** HAD ****** FAILURES DISTRIBUTED THUS
  ' FOR J = 1 TO SCNT(I) WRITE REMSRU(I,J) AS I 5 ,/
  '' LOOP
  ''SKIP 1 LINE  PRINT 2 LINES THUS
  '      ------------------------------------------
  ''             LRU SPARES REQUIREMENT
  ''  FOR I = 1 TO LCNT  WRITE SLRU(I) AS I 5
  ''     SKIP 1 LINE  PRINT 2 LINES        THUS
  ''       -----------------------------------------
  ''             SRU SPARES REQUIREMENT
  ''  FOR I = 1 TO LCNT DO
  ''  SKIP 1 LINE  PRINT 1 LINE WITH I  THUS
  ''    LRU NUMBER ***  SPARES
  ''  FOR J = 1 TO SCNT(I)  WRITE SSRU(I,J) AS I 5
  '' LOOP
  ''  LET ICOST = INT.HRS * 25.00 / MIL
  ''  LET DCOST = DEP.HRS * 50.00 / MIL
  ''   LET SE1=SE.COST(1) * SE.RQMT(1)
  ''   LET SE2=SE.COST(2) * SE.RQMT(2)
  ''  SKIP 2 LINES  PRINT 7 LINES WITH INT.HRS, DEP.HRS, SE.RQMT(1),
  ''   SE.RQMT(2)       THUS
  ''       ------------------------------------------
  ''           MAINTENANCE AND SUPPORT EQUIPMENT
  ''      I-LEVEL MANHOURS    =    ************
  ''      D-LEVEL MANHOURS    =    ************
  ''      O-LEVEL S.E. RQMT   =       ****
```

```
''      I-LEVEL S.E. RQMT  =      ****
''      D-LEVEL S.E. RQMT  =        1
''   LET TOT.SE = SE1 + SE2 + SE.COST(3)
  FOR I = 1 TO LCNT  DO                                    / MIL) + ←┐
  LET TOT.COST = (TRANS(I) / MIL) + (ANECP(I) / MIL) + (AN.SRU(I)-┘
(STOR(I) / MIL)+(TLCOST(I) / MIL)+(TSCOST(I) / MIL)+(ADM(I) / MIL)
LET TOT.MYP = (TRMY(I) / MIL ) + (CMY(I) / MIL ) + (CSMY(I) / MIL )
   (STMY(I) / MIL)+(MY.ECP(I) / MIL)+(MYSRU(I) / MIL)+(1000 / MIL)
SKIP 1 LINE  PRINT 12 LINES  WITH  NAME(I,1),NAME(I,2),
   TLCOST(I) / MIL, CMY(I) / MIL,
   TSCOST(I) / MIL, CSMY(I) / MIL, ANECP(I) / MIL, MY.ECP(I) / MIL,
   AN.SRU(I) / MIL, MYSRU(I) / MIL,
  TRANS(I) / MIL, MIL, STOR(I) / MIL, STMY(I) / MIL,
   ADM(I) / MIL, 1000 / MIL, TOT.COST, TOT.MYP  THUS
          ---------------------------------------------------------------
                     FINAL COST BREAKDOWN FOR      ******** ********
                                      ANNUAL                MYP
               LRU SPARES     =  $***********.****  $***********.****
               SRU SPARES     =  $***********.****  $***********.****
             LRU ECP COST     =  $***********.****  $***********.****
             SRU ECP COST     =  $***********.****  $***********.****
             TRANSPORTATION   =  $***********.****  $***********.****
              STORAGE         =  $***********.****  $***********.****
             ADMINISTRATION   =  $***********.****  $***********.****
                                  ----------------  ----------------
            TOTAL  COST       =  $***********.****  $***********.****
   SKIP 2 LINES PRINT 5 LINES WITH YRLRU(1,I),YRLRU(2,I),YRLRU(3,I),
     YRLRU(4,I),YRLRU(5,I),SLRU(I)     THUS
                    SPARES  BUILDUP BY YEAR
   YEAR        1        2        3        4        5         TOTAL

            -------  -------  -------  -------  -------     -------
             *****    *****    *****    *****    *****       *****
          ---------------------------------------------------------------
  SKIP 2 LINES PRINT 1 LINE THUS
        SPARES ANNUAL COST BY YEAR
         PRINT 4 DOUBLE LINES WITHLCST(1,I),TLCST(2,I),TLCST(3,I),
         TLCST(4,I),TLCST(5,I),TLCOST(I)    THUS
    YEAR          1                   2                3                4
                  5       TOTAL

  -------------      -------------  -------------  -------------
  -------------      -------------
  $***********.**    $***********.**  $***********.**  $***********.**
  $***********.**    $***********.**

  ---------------------------------------------------------------
  -----------------------------
      ''THIS ROUTINE COMPUTES INTERNAL RATE OF RETURN
       LET N = YR.REPORT
       LET FF(1) = TLCST(1,I) - CMY (I)
       WRITE FF(1) AS D(14,5),/
       FOR X = 2 TO 5 DO
        LET FF(X) = TLCST(X,I)
      WRITE FF(X) AS D(14,5),/
     LOOP
    ''LOWER BOUND OF INTEREST RATE = L
      ''UPPER BOUND OF INTEREST RATE = U
     LET L = 0.0
      LET U = 1.0
       '310' LET INT= L + (U-L)/2
        WRITE P,L,U,INT AS 4 D(12,5),/
        LET P = 0.0
```

```
       FOR  X = 1 TO N LET P = P+FF(X)/((INT+1)**X)
         IF P < .0005 AND P > -.0005
            WRITE  INT*100. AS "IRR = ",D(12,3),/ JUMP AHEAD
          ELSE
         IF P > .0005 LET L = INT GO TO 310 ELSE LET U = INT GO TO
                                                                 310
    HERE   LOOP
     SCHEDULE A REPORT IN 365 * YR.REPORT DAYS
      RETURN   END
  '' ***********************************************
  EVENT ECP
     FOR I = 1 TO LCNT DO
   ADD SLRU(I) * NLECP(I,YR.COUNT) * CLECP(I) TO ANECP(I)
    ADD  SLRU(I) * NLECP(I,YR.COUNT) * 30 TO TRANS(I)
   ADD SLRU(I) * 100 TO STOR(I)
      FOR J = 1 TO SCNT(I) DO
   ADD SSRU(I,J) * NSECP(I,J,YR.COUNT) * CSECP(I,J) TO AN.SRU(I)
   ADD SSRU(I,J) * NSECP(I,J,YR.COUNT) * 10 TO TRANS(I)
  ADD SSRU(I,J) * 15 TO STOR(I)
     LOOP
           LOOP
   ADD 1 TO YR.COUNT
    SCHEDULE A ECP IN 365 DAYS
   RETURN  END
  '' ***********************************************
    EVENT MULTI
    LET E.TOT = 0
    LET MYSRU(I) = 0.0
    LET MY.ECP(I) = 0.0
    FOR I = 1 TO LCNT DO
      ADD SLRU(I) * MYP(I) TO CMY(I)
   FOR M = 1 TO 5  DO
      ADD NLECP(I,M) TO E.TOT
     LOOP
  LET TRMY(I) = E.TOT * SLRU(I) * 30
  ADD SLRU(I) * 100 * YR.QUIT TO STMY(I)
    LET MY.ECP(I) = E.TOT * CLECP(I) * SLRU(I)
    LET E.TOT = 0
       FOR J = 1 TO SCNT(I) DO
          ADD SSRU(I,J) * SMYP(I,J) TO CSMY(I)
     FOR M = 1 TO 5   DO
     ADD NSECP(I,J,M) TO E.TOT
    LOOP
  ADD E.TOT * SSRU(I,J) * 10 TO TRMY(I)
   ADD SSRU(I,J) * 15 * YR.QUIT TO STMY(I)
    LET MYSRU(I) = E.TOT * CSECP(I,J) * SSRU(I,J)
    LET E.TOT = 0
     LOOP
                LOOP
    RETURN   END
  ''  ***********************************************
   EVENT ADMIN
    FOR I = 1 TO LCNT  DO
    FOR J = 1 TO YR.QUIT  DO
       IF YRLRU(J,I) > 0  ADD 1000 TO ADM(I)
        ALWAYS   LOOP
          LOOP
      RETURN   END
```

```
      *****************************************
      STOP      END
$       SOURCE
$       EXECUTE
$       LIMITS  50,50K,-3K,2000
$       FILE    B*,B1R
$       PRMFL   SL,R,S,CACI/SIM2LIB
$       PRMFL   17,R,S,CACI/SIMERR
$       DATA    05
$       SELECTA CMSEV
$       ENDJOB
```

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In recent years the Department of Defense has received a great deal of publicity concerning the acquisition of spare parts. The management of spare parts is big business. The spare parts portion of the Department of Defense (DOD) budget for FY86 was 22.4 billion. With this, DOD has procured about 700,000 spare parts.

The purpose of this research effort was to validate the MYP simulation model that was developed in 1985. Two separate approaches were used to validate the model. The first approach was to identify the key cost drivers associated with making a MYP decision. The second approach involved acquiring data on 18 F-16 spare parts that were similar to the 8 B-1B spare parts used to develop the model. A literature review and numerous interviews were performed in order to achieve the purpose of the thesis. This researech confirmed that the two major cost drivers for a MYP decision are: 1) acquisition savings due to buying material in larger quantities, and 2) the potential ECP costs. F-16 data was ran through the model to see how the model would work with another major weapon system that has different cost data, reliability and maintainability, quantities and mission profile. The data was ran through the model and the results supported the MYP decisions made at Air Logistics Center at Hill AFB, Utah. The purpose of this model is to aid the decision maker in making appropriate and timely MYP decisions.

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